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Henry W. Hall, Manager.

CHARLES W. PRICE.....Editor-in-Chief
A. A. GRAY.....Managing Editor
MORTON GITHENS LLOYD.....Technical Editor
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LAWS OF MAGNETIC ATTRACTION.

An example of the unsatisfactory way in which physical laws are very often stated in books of reference is brought to our attention by the article, on other pages of this issue, by Mr. Carl Hering, which deals with the statement of the laws of magnetic attraction. Mr. Hering has paid considerable attention heretofore to similar inadequate statements in our books, and created a wide discussion about two years ago by his paper before the American Institute of Electrical Engineers dealing with the statement of the law of electromagnetic induction.

In the present case he takes up the inverse square law of magnetic attraction, and shows that when it is attempted to apply this to a particular case difficulties may arise, and that it is necessary to exercise great care if one would be sure of securing correct results.

The inverse square law in its simplest form can, of course, only be applied in general to points, whereas material magnetic poles are usually spread over considerable areas. In applying the law, consequently, the question comes up as to what distance should be used, and of course except in the simplest cases it is not the least distance between this surface and the point which is the required quantity. There is an effective distance which can be determined and applied to the entire pole strength, but its value is not evident upon inspection. Of course, the correct force in the present case can be obtained by dividing the entire polar surface up into small elements and applying the law to each one of these, and then summing up the resulting forces with proper regard to their direction. Every trained physicist and every engineer who has made a study of mathematical physics will be familiar with the proper method of application of this law, and is not likely to be led into error by the usual form of statement, but, as Mr. Hering points out, one who is not already familiar with this subject may easily be led into error by referring to the inadequate statements and explanations of this law which are often given in textbooks.

The case is similar to one which frequently arises in photometric measurements, where the area of the source is considerable and it is not at a uniform distance from the photometer screen. If the distance to the center of figure or to the nearest point of the source is used in computing

the intensity, it will be found that the result depends upon the distance of the photometer screen, and here again confusion has sometimes resulted from a lack of discrimination in the application of the inverse-square law.

Mr. Hering seems right in his contention that these laws should be expressed in such a manner or with such qualifying explanation that anyone who has occasion to refer to them would imbibe sufficient information to apply the law in the proper way. As is pointed out in this article, the force acting upon a magnetic body can be more easily determined qualitatively by consideration of the lines of force in the field than by applying the law of attraction. It is universally true that the body will move into the part of the field which is stronger. While it is generally true that a ferromagnetic or paramagnetic body will place itself parallel to the lines of force of the field, this will not be the case if by turning into a different position the poles can move into a stronger part of the field. This was illustrated in the *Physikalische Zeitschrift* some two years ago by Prof. R. Gans.

ELECTRIC VEHICLE PROGRESS.

On other pages of this issue there appears an account of the development of the electric-vehicle business in Chicago with particular reference to the influence of the activities of the local central-station company in this direction. It is gratifying to note that the well directed efforts of this progressive company have been so substantially rewarded.

There is, however, still a vast undeveloped field to be cultivated and the apparently indifferent attitude assumed by central stations in a number of important cities can only be due to a lack of comprehension of the enormity and profitableness of the business.

It is true that the introduction of the electric vehicle, in any locality, presents a number of difficulties which the central-station company is forced to overcome. In some parts of the country the company is obliged to overcome the determined opposition of those whose experiences with the early electric vehicles were of an unhappy order. It takes a long time to overcome the prejudices of those who found the early vehicles costly to operate, inflexible in control, comparatively unreliable in continuity of service and short-lived as to battery equipment. In other localities the horse has held the field so long that mere custom makes it difficult to displace it.

However, the attitude of the purchaser is the main problem to solve in the introduction of the electric vehicle. With the pleasure vehicle this problem is much simplified, for the "electric" is becoming generally recognized as an economic necessity and its inherent advantages are now well known.

The chief obstacle to the introduction of the electric truck is the plain conservatism of the horse owner, and the presentation of the facts to that individual is the only means by which the central-station industry, and the manufacturers of vehicles and equipment, can reach the goal of profitable off-peak loads, extended sales and economic installations.

The electric truck is a machine capable of doing more than three times the work per day that can be handled by horses under favorable conditions. It is more reliable, advertises its owner as up-to-date and frequently shows a return of from thirty to fifty per cent on the investment. The electric truck is clean, free from dirt and odor and is capable of doing a full day's city or suburban work on one charge of the batteries with a margin to spare. Many supporters of the electric vehicle have been more or less ready to concede that good street conditions were a necessity for its successful operation. It is perfectly true that an electric vehicle will not travel as many miles on one charge under conditions of severe grades as it will on a level, but the successful operation of the electric truck in Cincinnati, Kansas City, Richmond, Va., and other cities known for their hills has convincingly proven its qualifications in this direction.

Another objection has been the question as to the ability of the electric vehicle to travel through the snow. The gasoline truck has no overload capacity. The electric truck is propelled by a series motor with its resulting overload capacity which is sufficient to operate the vehicle against any reasonable resistance of snow. In this connection it should also be pointed out that the electric vehicle is not affected by extreme cold, while the operation of the gasoline vehicle is seriously hindered sometimes by the freezing of the cooling water.

It is important that central stations and all manufacturers and dealers in electrical apparatus should not only advocate the electric vehicle on the basis of its many inherent advantages, but deliver their goods in it, as every electric wagon on the street helps in creating a sentiment favorable to this form of motive power.

A CENTRAL-STATION OPPORTUNITY.

At this season of the year merchants are annoyed by moisture collecting on their show windows, due to the warm damp air in the store striking the chilled window, which in the majority of cases totally obstructs the view of the passer-by who attempts to inspect the goods displayed.

An eight or ten-inch electric fan, depending upon the size of the window, installed so as to play its breeze over the surface of the glass tends to keep it clear and should be welcomed by merchants who rely, to a great extent, upon the advertising value of their window displays for additional business.

In this manner the service of the electric fan, which is ordinarily stored away during the winter months, could be greatly extended, making it a more profitable investment. Since the fan represents a very desirable load to the central station it is to the latter's interest also to have the fan

utilized during the winter months, and help to keep up the all-day load at this season.

A central-station campaign along these lines should be productive of good results.

THE IMPORTANCE OF POWER-PLANT DEVELOPMENT.

Every competent engineer realizes that the maintenance of continuous service in a large power plant furnishing electricity to a rapidly growing city requires a consistent development policy in which a reasonable appropriation is made from time to time for enlargements of generating capacity, with a willingness to spend money for the prevention of breakdowns and the maintenance of economical operation. To the credit of the electrical industry the average board of non-technical directors is rapidly coming to appreciate that receipts must in part be devoted to uses other than the meeting of ordinary operating expenses and dividend requirements if the quality of the service is to be kept at a high standard. Occasionally a plant of even considerable size will be found, however, in which a niggardly policy in regard to equipment development hampers the efficiency of the service and finally leads to acute criticism on the part of the public and resulting troubles which might wholly have been avoided if the administration of theproperty had been far-sighted with respect to extensions and improvements.

A typical instance of the results of a scrimping development policy is afforded by an electric railway plant which is attempting to supply power to a system of about 165 miles of track, including the car service of a city of nearly 150,000 inhabitants. For about seven years the plant has been gradually running down until it stands today one of the most unreliable in the country for a city of its size. It has become necessary to cut down the car service to the minimum, taking off some forty cars in the evening rush hour on account of insufficient power; and it is expected that if the cars are to be heated in the winter season fifteen additional units will have to be taken off in order to release the necessary output of the station for heater use. The effect of continued depreciation at the plant, combined with failures of piping at critical periods of the day has greatly hampered the service, and the system is facing the coming of heavy snows with little prospect of maintaining even the present much criticized service. The company is now running about 150 urban cars and fifty suburban cars, and is unable to increase the service with the present facilities. To add to the inconvenience of the situation, the station is located more than 1.5 miles from the center of the city; the distribution is almost all by 600-volt, direct-current lines, and the losses in transmission are so large that a considerable percentage of the remaining generator capacity is wasted, so far as transportation requirements are concerned.

These conditions of parsimony, illustrated by utter unwillingness to install additional equipment for the good part of a decade, have led to an avalanche of popular criticism and have placed the company in a most undesirable position at the outset of the winter. The policy is the outgrowth of one in which the company refused to pay its electrical engineer more than a bare living salary on a motorman's scale of subsistence, the technical aspects of its affairs being totally unappreciated by the old directorate. Fortunately a new management has the company in hand, and a genuine constructive policy is rapidly being put into effect by the erection of a new turbine station in a neighboring suburban town, with the installation of suitable substation equipment in the center of the city. When this apparatus is placed in service in the spring of next year, the old causes for complaint will largely be removed. In the meantime, the old management's novel arrangement of buying a few hundred kilowatts from a local central station five nights a week after 6 p. m. is still in effect, and unless the company finds it feasible to purchase current outside at a relatively high cost, the outlook for the next few months is anything but attractive. The situation illustrates the ultimate cost and trouble which are bound to result from a long continued failure to meet the requirements of an expanding load, and constitutes an impressive object lesson to the investor who is always reluctant to put money into the building up of a public-utility property. If the original management of the company had possessed the foresight to anticipate in even a small degree the growth of the city and the inevitable depreciation of its station equipment and need of new and higher-powered units, at least the foundations of a systematic development might have been laid; but instead, the penurious practice of trying to maintain the plant substantially at a constant rating for over seven years, under the stress and strain of frequent interruptions and the use of several low-capacity belted units in space that should have been occupied by compact, large, and efficient generator sets has brought the system to the verge of a protracted shortage of the reasonable service which the community has a right to demand.

TIME SIGNALS BY WIRELESS.

Soon after the adoption of standard time in this country, the practice of sending out time signals at noon each day from local astronomical observatories over the telegraph lines of certain railroads was inaugurated. Today the entire country receives similar service over the lines of the Western Union Telegraph Company from the Naval Observatory at Washington, this service having been inaugurated on January 1, 1889.

Lately the Navy Yard at Washington has been sending out similar signals by wireless, and now the Eiffel Tower has inaugurated a service which should prove of great convenience to mariners in case, for any reason, their chronometers should fail them.

Lamp Lighting Schedule.

The ELECTRICAL REVIEW AND WESTERN ELECTRICIAN has prepared for the year 1911 a schedule for lighting street lamps which shows in tabular form the proper time for lighting and extinguishing lamps on the moonlight schedule and the all-night schedule. The total number of hours of lighting each month is given for these two schedules and also for Frund's system and the moonlight-midnight system. By the latter is meant following the moonlight schedule until midnight, after which no lights are continued on any night.

This schedule is in the form of a sheet of convenient size, which forms an insert in a small booklet containing instructions and other information. The schedule sheet may be removed for posting on the wall for easy reference.

One copy of this lighting schedule will be sent free of charge to any subscriber requesting one. The price to others and for additional copies will be, as heretofore, ten cents.

Consolidated Traction Sold.

Under orders of Judge Grosscup of the United States Circuit Court the properties of the Consolidated Traction Company and its eight underlying companies were sold recently at auction for $1,425,000 to Andrew Cooke, representing bondholders.

Dallas to Have a White Way.

A committee of the Chamber of Commerce of Dallas, Tex., is making much headway with securing the co-operation of the merchants and property owners along its principal business street for the ornamental lighting thereof. It is proposed to make Elm Street between Market and Harwood Streets a brilliant "white way." Of the 6,000 feet of frontage nearly five-sixths has been signed up in favor of the improvement, thus assuring its early execution.

Governor of Indiana to Confer with Traction Men.

Because of the numerous disastrous interurban wrecks that have occurred in Indiana during the past half year Governor Marshall of that state has called a conference of officials and operators of interurban roads with him and the Railroad Commission at the Governor's office on December 13 to receive suggestions as to what recommendations the interurban people would advise to be made to the legislature to regulate or render interurban travel more secure to the public.

Elliott Cresson Medal Awards.

The Franklin Institute of Pennsylvania has awarded its Elliott Cresson gold medal, the highest award in the gift of the Institute, to Edward Weston, Ernest Rutherford, J. J. Thomson, Robert A. Hadfield, H. W. Wiley, John Fritz and John A. Brashear.

This medal is awarded to distinguished scientists and technologists for meritorious work in furthering science and industry. The present awards are made for distinguished leading and directive work in the respective specialties of the recipients.

Electrical Exports for October.

The Bureau of Statistics of the Department of Commerce and Labor, Washington, D. C., has completed its monthly summary of the imports and exports of the United States for the month of October. From this the following facts relative to the exports of electrical products are taken.

The figures for October show that the total of electrical exports was considerably greater in that month than in the corresponding period last year, there being an improvement in both appliance and machinery exports. On the other hand, as compared with the preceding month, September, 1910, there was a falling off in machinery shipments greater than the gain in appliance exports; the total electrical exports were therefore somewhat less than in September. The reasons for this are hard to determine.

The comparative monthly data are as follows:

Electrical—	October, 1910	September, 1910	October, 1909
Appliances	$ 780,233	$ 762,152	$ 683,819
Machinery	514,184	578,246	443,388
Total	$1,294,417	$1,340,398	$1,127,207

The principal countries to which electrical exports were sent in October and the values of these shipments were as follows:

Exported to—	—Electrical— Appliances.	Machinery.
United Kingdom	$ 32,477	$ 36,363
Other European countries.	20,273	41,080
Canada	167,249	106,318
Mexico	88,898	68,982
Cuba	53,194	8,509
Brazil	107,883	32,758
Other South American countries	68,939	54,026
Japan	92,034	59,950

Chicago Section, Illuminating Engineering Society.

The next meeting of the Chicago Section of the Illuminating Engineering Society will be held in the Great Northern Hotel, Chicago, at noon on December 15. Professor J. M. Bryant and H. G. Hake, of the department of electrical engineering, University of Illinois, will present a paper giving the results of some original research work on "Comparative Costs of Producing Light with Different Illuminants." The meeting will be preceded by the customary luncheon.

Eastern New York Section of the National Electric Light Association.

Plans have been recently perfected for active work on the part of the Eastern New York Section of the National Electric Light Association. The first general meeting of the season will be held at Schenectady on December 13, and President W. W. Freeman of the National Electric Light Association will describe at that time the wonderful growth of the Association and its work in solving practical commercial problems of the electrical industry. Secretary T. Commerford Martin will also address this meeting.

The Eastern New York Section already has 140 members, and the membership committee, of which W. E. Brown of Schenectady is chairman, is making an active campaign among the central-station men.

The officers of the new section are: President, B. E. Morrow, Hudson River Electric Power Company, Albany, N. Y.; vice-president, M. O. Troy, General Electric Company, Schenectady, N. Y.; treasurer, T. A. Kenney, Hudson River Electric Power Company, Albany, N. Y.; secretary, R. H. Carlton, General Electric Company, Schenectady, N. Y.

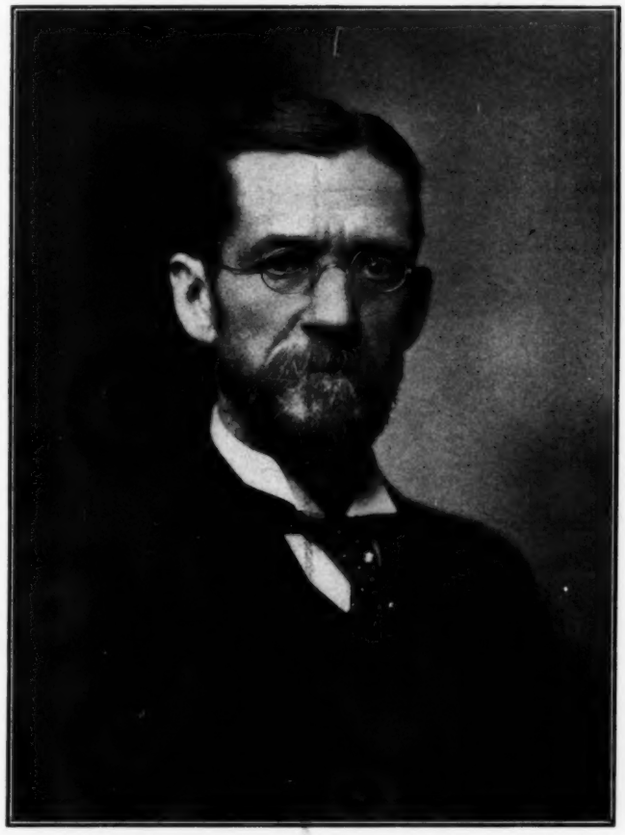
The executive committee is composed of the following members: B. E. Morrow, Hudson River Electric Power Company, Albany, N. Y., chairman; C. D. Haskins, M. Webb Offutt, A. A. Anderson, J. C. DeLong and F. H. Gale.

Time-Signals from Eiffel Tower.

The proposed wireless time-signal service from the Eiffel tower was inaugurated on November 21, and mariners can now receive signals at midnight and 11:00 a. m., except on Sundays and holidays.

Henry S. Carhart.

Professor Henry Smith Carhart was born at Coeymans, Albany County, N. Y., March 27, 1844. His early years were spent on his father's farm, and his education secured at the district school. He showed an aptitude for teaching early in life, and at sixteen was an instructor and looking forward to a collegiate course of study. When he was nineteen years old he was the head of a Quaker school near Poughkeepsie, N. Y., through which he was securing the means for the completion of his preparatory course at the Hudson River Institute, at Claverack. He was admitted to Yale College in the summer of 1865, but at the opening of the college year entered the Wesleyan University at Middletown, Conn., from which he was graduated as valedictorian of his class in 1869. After graduating he was for two years teacher of Latin at Claverack. He then entered the Yale Divinity School, and becoming acquainted with the advantages offered by the Sheffield Scientific School, he turned his thought from theology to the pursuit of knowledge in pure and applied sciences. He accepted an appointment in the Northwestern University, at Evanston, Ill., in 1872, first as instructor and the next year as professor of physics, filling this chair until appointed professor of physics at the University of Michigan in 1886. In 1893 Wesleyan University conferred on him the degree of LL. D., the highest honorary degree.



HENRY S. CARHART,
Emeritus Professor at University of Michigan.

While at Evanston, Professor Carhart was also instructor in chemistry, his preparation for this work being sought in the summer school of chemistry at Harvard. During Professor Carhart's incumbency at Evanston the study of physics had received a wonderful impetus and an extraordinary growth, and from a most meager beginning the physical laboratory had developed into one of the most comprehensive collections of apparatus housed in a fine laboratory which had been constructed at a cost of $45,000. During his incumbency at the University of Michigan the same great change has taken place, and under the direction of Professor Carhart a splendid course and equipment developed.

Professor Carhart has been prominently identified with scientific occasions and he has become a figure of international reputation. In 1881, while still at Evanston, he was granted leave of absence for a year, which he spent abroad. He attended the Paris Exposition of Electricity as one of the international jurors of awards of the United States, after which his time was chiefly given to study and experimental work at the Helmholtz laboratory at the University of Berlin. While thus engaged he undertook an investigation, having for his object the determination of the relation between the electromotive force and the density of the zinc-sulphate solution in a Daniell cell. This work attracted the attention of the greatest physicists of the day and was, in fact, the beginning of what Professor Carhart has since developed into the production of a standard cell for the measurement of electromotive force. This cell has a small temperature coefficient.

Professor Carhart was made emeritus professor of physics in 1909 at the University of Michigan, and he is now in Washington undertaking an investigation connected with the standard cell at the Bureau of Standards.

Dr. Carhart has contributed many articles to the scientific press, and is the author of several textbooks. He has also delivered quite a number of popular lectures. He is a fellow and has been a vice-president of the American Association for the Advancement of Science; he is a member of the Institution of Electrical Engineers of Great Britain, of the American Institute of Electrical Engineers, and of the American Physical Society, and a member and past president of the American Electrochemical Society. In addition to his services at the Paris Exposition in 1881, he was president of the board of judges of the Department of Electricity at the Chicago Exposition in 1893, member of the jury of awards at the Buffalo Exposition in 1901, United States delegate of the International Electrical Congress in Chicago in 1903, and St. Louis in 1904. He was a guest of the British Association for the Advancement of Science on its trip to South Africa in 1905. He was a member of the Berlin Conference on Electrical Units and Standards at Berlin in 1905, and a United States delegate to a similar conference in London in 1908.

1912 Boston Electrical Show.

The 1912 Boston Electrical Show will be held in the Mechanics Building, from September 28 to October 26, under the auspices of the Edison Illuminating Company of Boston. There will be 105,000 square feet of exhibit space, and the organizers are making every effort for its success. The following executive board has been appointed: H. W. Moses, manager; C. I. Campbell, associate manager; L. D. Gibbs, superintendent of advertising, with headquarters at 39 Boylston Street, Boston.

Meeting of Central Electric Railway Association.

The regular bi-monthly meeting of the Central Electric Railway Association, with headquarters in Indianapolis, was held at the Phillips House, Dayton, Ohio, December 1.

The meeting was called to order at 10 o'clock by George Whysall, of Marion, Ohio, president of the Association. The first paper to be read was by H. S. Williams on "Recent Developments in Car Heating." Mr. Williams described in a very interesting manner what he considered the newest and best system of car heating—a system combining heating with ventilation.

The heater consists of a stove and an electric motor which operates a blower. This blower draws the cold air from the outside over the heated surfaces of the stove and then drives it into the interior of the car. In this manner fresh warm air is distributed to all parts of the car. He said that electric cars have made the electric heater possible. The development of high-speed cars, and the education of the traveling public to modern conveniences has made it necessary to furnish adequate facilities for ventilation. The modern requirements to meet conditions are that the heat within the car should be maintained at a given point, and that fresh air must be introduced into the car to keep up the standard of purity and so controlled as to avoid disagreeable draft.

Mr. Williams spoke of the probable adoption of a type of car in which the monitor roof will be modified with a view of doing away with a large area of glass. He described conditions to be dealt with in the heating of street cars and spoke of the economical and effective heating results secured by the use of the combined heating and ventilating system.

In the discussion of this paper a number of questions were asked Mr. Williams, who took them up separately. In case of a break in power he said the heater would continue to heat the car successfully by opening the door and allowing the heat to pass into the car. He recommended the removal of the heating outfit, which weighs about 230 pounds, from the car during summer time. This is dead weight, he thought. Mr. Williams, in response to a suggestion, thought it rather impracticable to install an automatic regulator. In reply to a question Mr. Williams said it was possible to grade the size of the openings in a three-apartment car so as to equalize the heat in a manner to successfully heat the entire car. He said this could be accomplished by having ejectors in the roof.

The second paper, on the subject of "Wood Preservation," was presented by A. L. Kuehn, general superintendent of the American Creosoting Company, of Chicago. Mr. Kuehn's paper received close attention, it being a subject of considerable interest to traction companies. He said the general opinion is that the use of wood is on the wane because of its scarcity and for that reason concrete and steel are being extensively used in the construction of modern cars and roadbeds. However, statistics show that the demand for wood to be used in the construction of electric street and interurban cars is greater than at any previous period.

The causes of decay of the fiber of wood, supplemented with the methods that are now in use for preventing this decay, were thoroughly described. The speaker illustrated the methods of application of the treatments of timber in a modern wood-preserving plant.

The chief points brought out in the discussion of this paper were as to the best kind of timber to be treated for ties. Mr. Kuehn said chestnut timber was not the best for treatment to be used as ties, but regarded white oak, red oak and beech good lasting timber for ties after treatment. As to the question of life he replied that ties are said to have lasted from 40 to 50 years in France and in some instances were serviceable for a further use of perhaps 20 years after subjecting them to a preservative treatment.

The afternoon session was opened by the reading of a paper on "Traffic" by W. O. Woodard, traffic manager of the Chicago, Lake Shore & South Bend Railway.

This paper was discussed very fully, a number of delegates recounting their experiences in this department of railway work.

The fourth and concluding paper was read by T. W. Williams, representative General Electric Company, on "Gears and Pinions." The proper selection and treatment of steel for the manufacture of railway motor gears and pinions has received very special attention during recent years, according to Mr. Williams. He claimed this is necessary in order to greatly increase the life of gears and pinions used on roads which had hitherto experienced great trouble from breakage and rapid wear. He said the most important factors entering into the cause are: The proper selection and treatment of steel; the effect of wear of axle and armature bearings, causing improper alinement of gear and pinion teeth, and the proper method of lubrication.

These factors were each discussed by the speaker and the various processes described minutely as well as illustrated.

Mr. Williams' paper aroused a very generous discussion relative to the use of treated gears and pinions and the reduction of cost and trouble. Some of the members thought there was a great deal of misunderstanding regarding proper lubrication of gears and insisted that a small quantity at the proper time and place was better than a large amount at greater intervals.

The next meeting of the convention to be held in Indianapolis January 19 will be the annual meeting, at which time the election of officers will be held. This meeting it is expected will be largely attended.

New Western Union Service.

With the new wire and mail service inaugurated by the Western Union Telegraph Company it is possible for a San Francisco merchant to dictate a letter in the morning and be reasonably certain that it will be placed aboard a boat sailing from New York on the afternoon of the same day.

The merchant's letter will be received by the telegraph company precisely as a message would be received, transmitted across the continent at the usual tolls and the copy at the New York end will be placed in a special sealed envelope, addressed as directed, and rushed to any available steamship. The only extra charge will be five cents for postage.

Toledo Section of the American Institute of Electrical Engineers.

At the meeting of the Toledo Section of the American Institute of Electrical Engineers, held at Toledo, O., on December 2, C. B. Cooke spoke on the subject, "Adaptability of the Electric Motor."

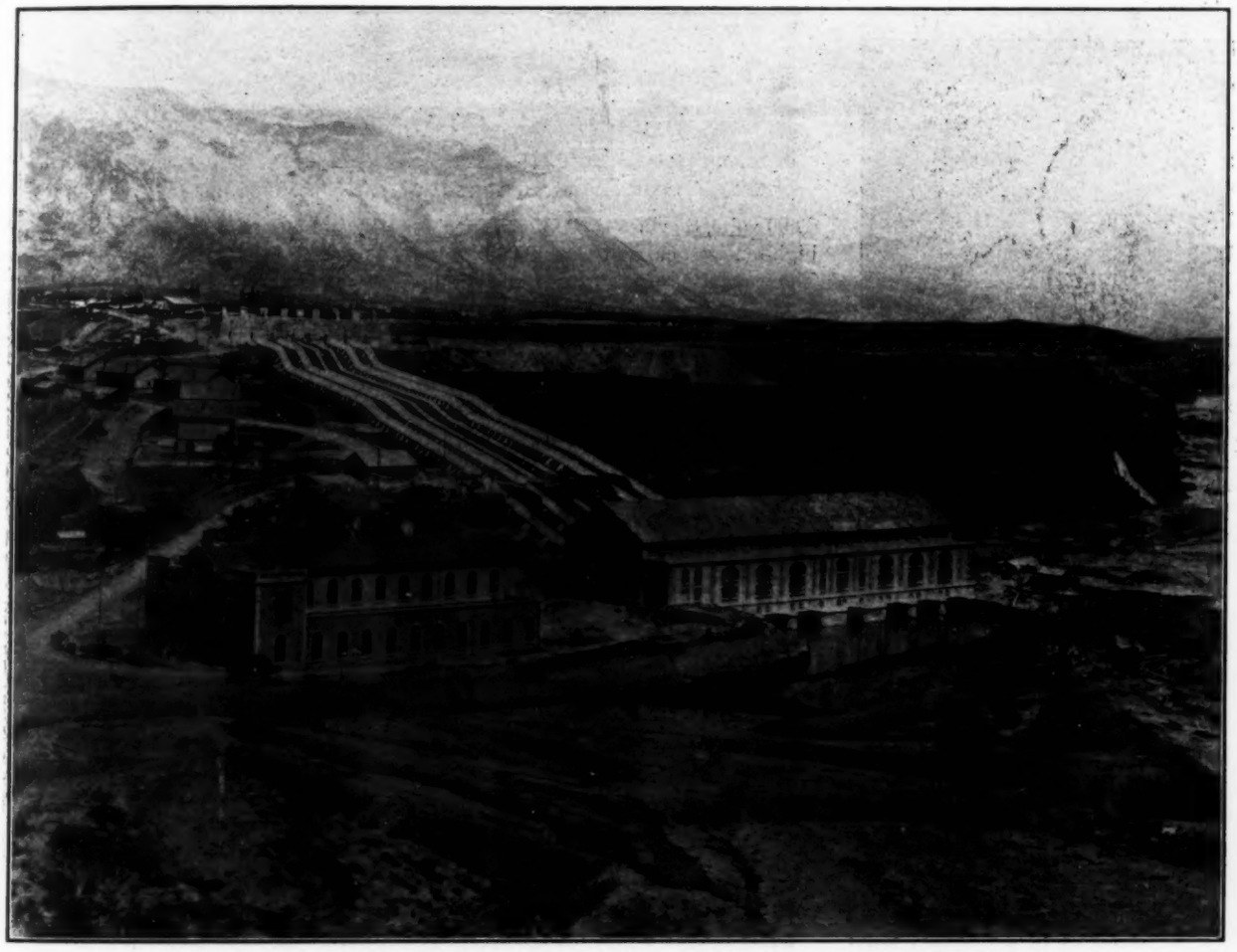
The Ventavon Hydroelectric Plant.

Description of a Modern 30,000-Horsepower Plant in France.

BY C. L. DURAND.

A new hydroelectric plant which ranks among the largest in Europe has been recently added to the power system in France controlled by the Energie Electrique Company. The present plant, known as the Ventavon station, was erected in order to meet the increasing demand for current in the neighborhoods of Marseilles and Arles. ultimate output of 30,000 horsepower, and adjoining it is a separate building for the step-up transformers. From the transformer house is run a three-phase, 60,000-volt double power line, which is constructed of aluminum cable, and runs across a mountainous country along the Durance River, connecting the Ventavon plant with the Brillanne speed of 300 revolutions per minute, and giving 6,000 horsepower. The turbine works under a head of water of fifty meters, and is direct-coupled by horizontal shaft to a three-phase alternator of 5,000 kilowatts, giving 7,000 to 8,000 volts between phases and a frequency of twenty-five cycles.

In connection with the four principal



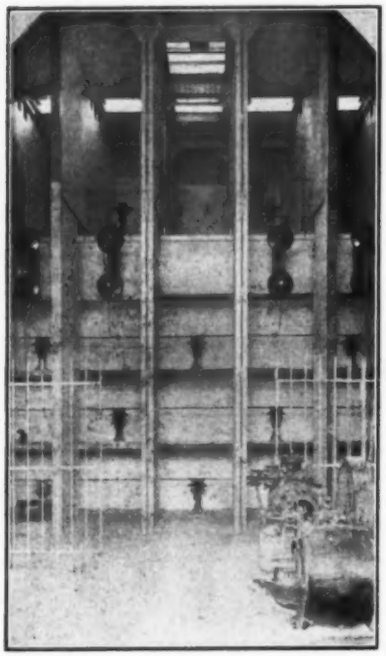
GENERAL VIEW OF VENTAVON HYDROELECTRIC PROJECT ON DURANCE RIVER, FRANCE.

The Ventavon plant is located on the Durance River in the Mediterranean Alpine region and is situated some forty miles above the recently erected Brillanne station. A dam has been constructed on the Durance at this point, together with an intake canal nine miles long. At the end of the canal is erected a turbine station which has an station and from thence to the main power network.

Referring to the general view of the turbine and dynamo room, the station is laid out for six principal units. At present there are four of these installed and in running order. Each unit consists of a turbine of the Francis type, of French make, running at a standard alternators of the station there are installed transformers connected with the alternators so as to allow for the independent working of the two overhead power lines so that the current of the four machines can be distributed in the desired way upon these lines and in the best possible manner. In order to carry this out, each alternator can send its

current either directly into a separate bank of these transformers, which serve to raise the voltage on the line, or into one of the two sets of 7,500-volt busbars, and allowing any one of the transformer groups to be fed from any desired alternator. In the former case each group of three transformers operates in connection with the alternator which is allotted to it.

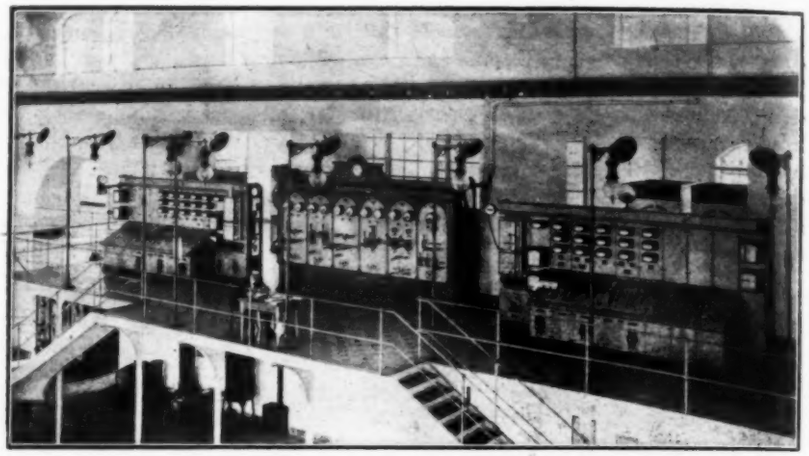
On the other hand, each group of transformers may be connected upon one of the pair of 60,000-volt busbars of the high-voltage circuit. Each of these bars serves to supply one of the outgoing power lines of the plant. Three different connections between



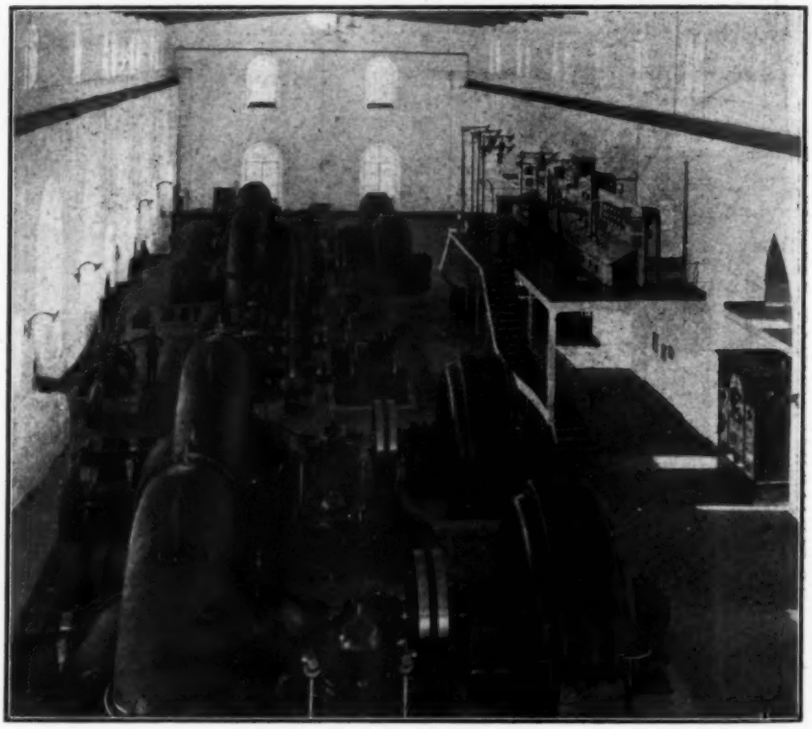
VIEW OF HIGH-TENSION STRUCTURE.

machines, transformers and busbars are carried out by three-pole switches with copper knife blades, and these switches are arranged to be operated either by hand or by a small direct-current motor which works on a 120-volt circuit.

The step-up transformers of the station are mounted in a separate building from the main plant, which lies at some 350 feet distant. The transformers are of the Thomson-Houston three-phase type and at present there are twelve units installed, each transformer being mounted in a separate cell. The capacity of these units is 1,300 kilowatts, and the ratio of transformation is 1 to 4.2. Each group of three transformers corresponding to one of the alternators is connected to this machine by three single-phase cables, which are lead covered and have paper insulation. The three transformers of a group are connected in delta on the low-tension side and in star for the high-tension circuits. Supplied with current at 8,000 volts, they are thus able to furnish high-tension current at 58,000 volts. The capacity of a transformer group corresponds to that of the alternator to which it is connected and it is able to support an overload of twenty-five per cent. In the shop test which was given to the transformers there was applied in the first place 110,000 volts between the primary and the secondary connected to iron, and on the second test, 15,000 volts between secondary and iron. When installed in the plant there was made a half-hour test with 57,000 volts between phases, one pole being connected to ground. In the case of the present transformers, there is used a special method for drying the coils after winding. Each group of three transformers is short-circuited on the high-tension side and fed at low tension by the corresponding alternator, while a vacuum of sixty centimeters of mercury is kept up in the transformer tank by a motor-driven air pump. The temperature of the high-tension winding

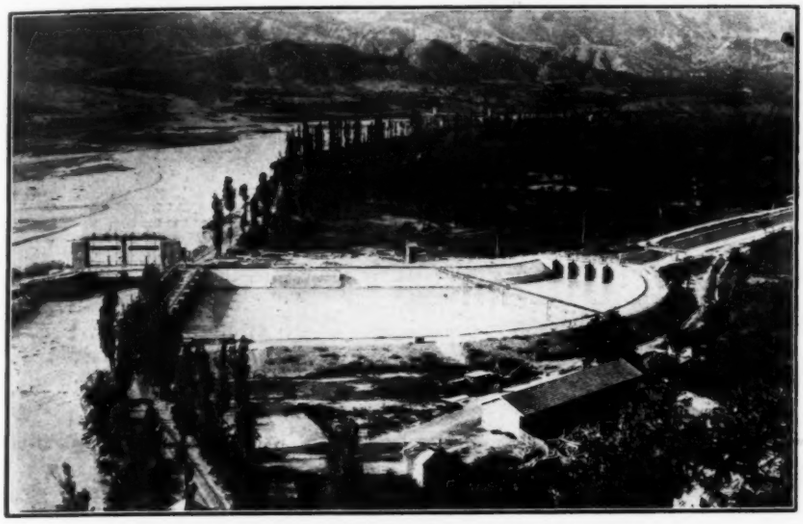


MAIN SWITCHBOARD AND BENCHBOARDS



GENERATING ROOM, VENTAVON HYDROELECTRIC PLANT.

while being thus dried is taken every half hour by measuring its resistance, using for the purpose a 120-volt direct-current circuit. Such heating is kept up for twelve hours at a temperature of about seventy-five degrees centigrade.

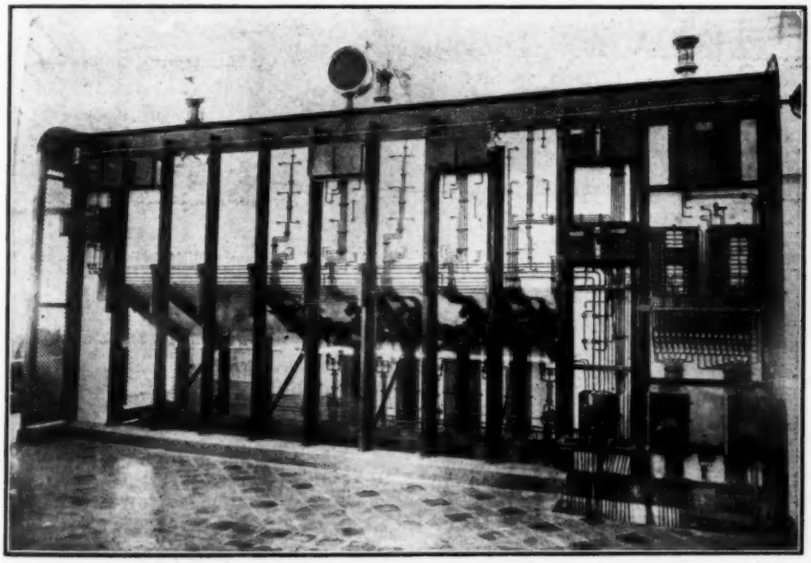


VIEW OF INTAKE FROM DURANCE RIVER.

During the last hour of the heat the tank is filled with oil, and this latter is freed from all traces of moisture by a prolonged heating in a suitable boiler.

Water for cooling the present transformers is supplied by the hydraulic system of the plant by suitable piping, and before passing into the transformers it is run through a set of filters in order to free it from the deposits which are contained in large quantity in the water of the Durance, especially during the season of freshets. The water then passes in the worm tubing of the transformer tank.

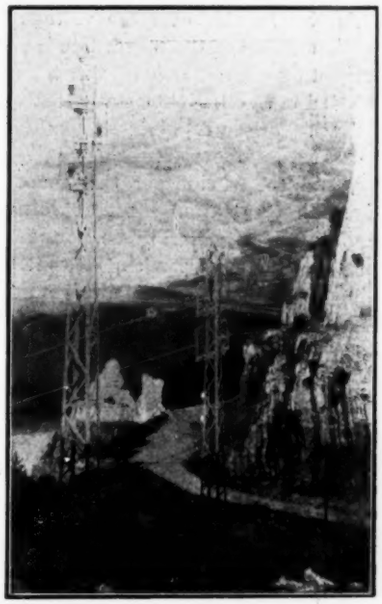
The 60,000-volt high-tension busbars which receive the current of the transformers are made of base-copper tubing and are supported upon high-voltage insulators. The present busbars are mounted in a horizontal position and are separated by partition walls in reinforced concrete. The connections for high tension, of base-copper wire, are also partitioned along their course and are protected from handling by means of wire netting.



REAR VIEW OF SWITCHBOARD.

At the station-end of the outgoing power lines there are used different protecting devices against undue rise of voltage coming from atmospheric disturbances, and in this region such devices are specially needed. First is used a system of lightning arresters of the electrolytic type. A second type of lightning arrester is used at the Ventavon station, this being the water-jet type, and each phase of the line is grounded. by means of a vertical water column, of eight millimeters in diameter and 0.80 meters height, the water striking against the inside of a bronze bell which is connected to the line wire. This lightning arrester is used principally to take off the static charges from the line in a continuous manner. In addition to these, the Wirt ball lightning arrester is also employed in the plant.

In one of the accompanying illustrations is shown the main switchboard in the Vantavon plant, which is designed for controlling the units of the dynamo room and the transformer house, as well as the different high and low-tension circuits. The switchboard is mounted in a gallery at one side of the dynamo room. Each unit composed of an alternator with its transformer group takes one panel of the switchboard carrying the required indicating and measuring apparatus. On the bench board there are placed the switches for operating the small motors for working the switches and the field rheostats of the alternators, and for the motors used to synchronize the turbines. On the board is also a complete diagram of the station circuits made up of copper strips fixed on the marble. The switches of the various circuits are



PORTION OF PARALLEL TRANSMISSION LINE.

here represented by small pilot lamps, and the circuit of such lamps is opened or closed by the attendant when he operates the corresponding switches. Inspection of the board thus shows the working of the whole plant at a glance and is of value in preventing false maneuvers.

On the switchboard proper the voltage does not exceed 120 volts, and this current is supplied by instrument transformers, with the primary connected on the 7,500 or the 60,000-volt circuits.

The present plant is designed to work in parallel with the already existing hydroelectric plant of Brillanne in the Mediterranean Alps region, and the current from the combined plants is sent over a power line to Marseilles or to Arles. In this case the voltage at the distant end of the power line is regulated by instruments which are mounted in the Brillanne station. However, the present plant at Ventavon can be used alone upon the same power line, and to provide for this there is placed in the station a set of voltage regulators. In general, the voltage is regulated for the other end of the 100-mile power line and this line ends in the large transformer station at Allauch, near Marseilles.

Notwithstanding the fact that on this long line the drop in voltage varies widely with the current and the power factor, the apparatus allows of a very good regulation at the far end, and the voltage can be kept at a practically constant point at Marseilles. To carry this out, each of the outgoing power lines of the Ventavon station is provided with a regulator of the Tirrill type, designed by the Thomson-Houston Company. The apparatus gives an instantaneous regulation of the voltage of the exciter which supplies the field of each alternator, so that the alternator voltage represents at all times the sum of the standard voltage at the far end of the line and the drop in the latter. The object of the regulator is thus to vary the exciter voltage so as to correspond to the variable load on the power line and the impedance of this latter, and it is required to compensate for the armature reaction of the alternators as well as for the loss in the line. This double result is obtained by a set of oscillating contacts which short circuit or throw in the field rheostat of the exciter. The line carrying the voltage, which is to be kept constant, is made to work a solenoid which operates the above contacts in the proper way for regulating. For the solenoid there is used a 110-volt circuit supplied by transformers.

Owing to the character of the country traversed by the transmission line, as well as the large amount of power which it carries, there are some points of its construction which are worthy of notice. In order to connect the present hydroelectric plant of Ventavon with the Brillanne turbine station as we mentioned above, it was decided to erect a double power line using two separate sets of poles, on account of the high power, as well as to give an additional security in working the plant. The two power lines follow a course through a mountainous region and run nearly parallel to the Durance River, the total length between the two hydroelectric plants being about forty miles. The two lines are spaced at a minimum distance of fifteen meters apart. It was a somewhat difficult matter to erect these power lines on account of the mountainous and rocky character of this part of the country, and at least two-thirds of the holes which were dug to receive the metallic poles to a depth of two meters required blasting in the rock. In many places the poles had to be planted on the abrupt mountain side.

About 1,700 metallic poles were used for the whole of the power line, and these are of high quality steel, having a total height of fifteen meters, of which two meters are fixed in a mass of concrete flush with the soil. There were adopted three different standard types of pole. For seventy-five per cent of the work, a pole having four corner pieces of angle iron, the base forming a square section of 900 millimeters, with a 400-millimeter section at the top, was adopted. The weight of the pole is about one long ton. The second type, used for fifteen per cent of the line and for angles below twenty-two degrees, embodied the same design, but is heavier, the total weight being 1.3 tons. For ten per cent of the work a pole is employed where the angles are less than forty-five degrees. The base is 1,100 millimeters square and the top 900 millimeters, and the weight is 1.8 tons.

Each of the two power lines consists of a three-phase, 60-000-volt line, and the first set of poles also carries a telephone line mounted below the former. A ground cable is mounted at the top of the pole and serves to connect all the poles of the series. A view of the transmission line and detail of the poles is shown in the accompanying illustration.

Aluminum cable is used for the power line throughout the whole of the course, and the section of the cable is 130 square millimeters. The joints in the cable are made by using an aluminum tube and twisting together in the well-known manner. Great care was taken in regulating the span of the cables owing to the temperature conditions which prevail in the mountain region. An initial tension had to be chosen so that under the most unfavorable conditions the metal is still worked at a high coefficient of safety. Outside of the straight lines, where three or four spans can be regulated at a time, it was found preferable to adjust each span, taking account of the temperature. Thus it is found that admitting an initial tension of 1.75 kilogrammes per square millimeter at fifteen degrees centigrade upon an average span of seventy-five meters, the sag of the aluminum cable varies between one meter for ten degrees temperature and 1.50 meters for thirty-five degrees. It will be seen that the difference in the sag is great under such conditions.

The porcelain insulators were designed specially for the present plant, and they are made in three pieces separately baked, and then assembled with Portland cement. The total height of the insulator is 350 millimeters and the diameter of the upper bell is also 350 millimeters. Aluminum binding wires are used to mount the cable upon the insulators.

Among the precautions which are used for the telephone line, may be mentioned that it is connected to the telephone apparatus in each of the stations by means of special transformers and insulated for 30,000 volts. In this way the proper security is afforded to persons when using the telephone. The line in this case is a three-millimeter copper wire supported on porcelain insulators, these being bolted direct onto the pole below the three-phase wires.

The ground cable which connects all the poles is a fifty-square-millimeter steel cable.

Both the 60,000-volt lines have been in operation for several months past, and the Ventavon station is supplying current to the power network of the Energie Electrique Company.

USUAL STATEMENT OF LAWS OF MAGNETIC ATTRACTION MAY MISLEAD.

BY CARL HERING.

The laws of magnetic attraction, as stated in the usual textbooks, and in books on physics, tell us that the magnetic attraction is inversely as the square of the distance. From this it would naturally follow that if a particle of iron be placed in the magnetic field between a north and a south pole, it would be attracted toward that pole to which it is nearest.

If this law, which has been copied from book to book for many years, is adequately stated, it should apply to all cases, and by means of it we ought to be able to predict correctly what the result will be in any particular case.

The following simple little experiment will, however, show that this law, as universally stated, is misleading, and that the actual result may be directly opposite to that which would be predicted by that law. Moreover, this is not an absurd or distorted case, but on the contrary is a very practical one; it in fact came up in the writer's practice in the designing of magnetic separators, and it was because the writer knew that the law as usually stated would mislead one in this case, because it applied to theoretical point poles, that the experiment was planned and carried out.

If in the above mentioned case, the two poles are shaped alike, it is true that the particle of iron will be attracted to the nearest pole. But if the two poles differ from each other in shape, the law may or may not agree with the facts. Nothing however is said about this condition in the text books where this law is given. Hence the law as usually stated is inadequate and may mislead one greatly in practice, as for instance in the designing of magnetic separators, and the latter are certainly very practical applications of magnetism.

The experiment is as follows: Let S in the adjoining Fig. 1 be a large flat piece of iron; and let N be the pole of a magnet; this pole is pointed. Let P be a small particle of iron, like a small iron filing or other fragment of iron such as magnetic separators are supposed to remove from nonmagnetic materials. The position of this particle P is very near but not touching the iron plate S, which forms the other "pole" of the magnetic field. Moreover it is relatively much farther from the other pole N.

According to the law as usually stated, taken literally, P should move to the nearest pole S. But the facts

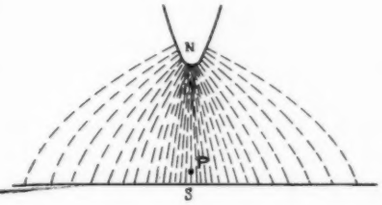


FIG. 1.

are that it will be attracted to the more distant pole N, even to the extent of being lifted up against gravity, while the pull toward the near pole S is aided by gravity.

If the particle actually touches the plate S it will not be lifted off, but the thickness of one or more sheets of paper between S and P will suffice, even though in accordance with the inverse square law the attraction should be immensely greater toward the near pole S.

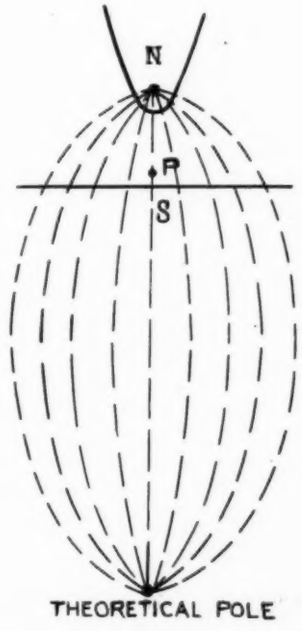


FIG. 2.

There is therefore something wrong with the statement of the law. An expert physicist can of course apply the usual statement of the law so as to fit these facts, but the fact remains and cannot be denied, that, taking the law as stated in books, certainly no one would have predicted by it, the true result; on the contrary, one would have predicted quite the opposite. Hence, following that law, one could not have thought of designing a magnetic separator in which the opposite to that law holds good; and without trying the experiment, a theorist would have condemned a separator designed on such principles, when as a fact it is an important feature to take into consideration in the design of such machines.

The physicist will probably explain the discrepancy by saying that the large pole S is really the equivalent of a theoretical point pole located very far below it, and giving the same distribution of magnetism around the point P, and in that case P is nearer to N than to S. (See Fig. 2.) The explanation is simple after the facts are known, but would the student have predicted those results from the law as usually stated? Surely not.

The true universal law, and the one which is of the greatest importance in designing magnetic separators, seems to be that a magnetic particle will always tend to move into a denser field, and will not move unless it can move into a denser field. Also that the greater the change of field density, the greater the moving force. In a field like that of the earth, in which all the lines of force are parallel, there is absolutely no tendency for a particle of iron to move because the field density is everywhere the same.

It is admitted that the older inverse-square law is a very useful one to the mathematical physicist. But in teaching the coming practical designing engineer, the writer maintains that greater care should be taken to state the laws of nature in such a way that the designer can best use them in practice, and by no means should they be stated so that the results in practice would be the direct opposite to those deduced from the laws.

As a case of looseness and carelessness in the statement of natural laws in text books, it is like the one to which the writer called attention some years ago, namely the law that "like currents attract and unlike repel" which is not correct. If it were, the current density in the middle of a wire would have to be greater than near the outside, and Ohm's law would therefore no longer apply to thick wires. It is

the conductor, that is, the material through which the current flows, which is attracted or repelled and not the currents *per se*. This is illustrated very strikingly in the so called "pinch" phenomenon, discovered by the writer some years ago, and which places a very serious and unexpected limit to the temperature in some forms of electric resistance furnaces. This important phenomenon would certainly not have been predicted by the usual statement of the laws.

SIMPLIFIED DIRECT-CURRENT MOTOR OR GENERATOR.

BY JAMES ASHER.

It was long ago pointed out by John and Edward Hopkinson, in England, that an ordinary direct-current motor would run without utilizing the wire on the field magnets, provided a positive lead was given to the brushes. The same scientists also pointed out that a direct-current generator would run without utilizing the wire of the field, provided a negative lead was given to the brushes. Thus it appears that direct-current motors and generators can be made to operate without any wire on the field magnets. Destructive sparking at the commutator occurs when motors and generators are used without wire on the fields. The writer has long been of opinion that a simple modification of such motors and generators would render them quite practicable.

Motors and generators operated as described above, with wire on the armature only, have the desirable quality of regulating for constant potential, enormous torque when the lead is about forty-five degrees when used as a motor, and great voltage when the lead is about forty-five degrees, and the machine is used as a generator. The machine weighs and costs considerably less than others, inasmuch as no field coils are required.

It recently occurred to the writer that by a simple modification of the machines as described above, considerable advantages may be secured by merely setting a small commutating pole either on or alongside each main bare pole. The brushes are so set on the commutator that the short-circuited coil is under the commutating pole. Of course poles for stopping the current in the short-circuited coil, and setting up another in the contrary direction, have long been used with machines otherwise constructed in the ordinary way. Such poles are often called interpoles, and they stand midway between the main poles. They are always in series with the current from the armature.

Now, if such a suggestion should prove thoroughly practicable, we shall be able to make machines which will regulate better than the best compound machines, and which will cost and weigh considerably less.

One drawback of the machine which I have just proposed is that, when used as a motor, it is impossible to reverse the direction of motion. In motors intended for reversing, a small commutative pole could be placed on either side of each main pole. Then when rotation in one direction is required all the commutating poles on one side of each neutral or bare pole would be thrown into series with the armature, and when reversal is required the current is cut off from these commutating poles, and sent around those on the opposite sides of the main pole pieces. The commutating poles are in series with the armature.

Asbestos in the United States.

The United States has for years led all other countries in the manufacture of asbestos goods, but until recently all the raw asbestos used has been imported from Canada, where there are nineteen quarries and mills, having a capacity of 8,250 tons of rock a day and employing in summer more than 3,000 persons.

No asbestos of the higher grade (serpentine asbestos, or chrysotile) was mined in the United States until 1908, but in that year Vermont produced some chrysotile and in 1909 mined a larger quantity, amounting to nearly one-twentieth of the Canadian output. Chrysotile asbestos has been mined in small quantities in Wyoming during the present year.

Steinmetz at Schenectady Section.

At a meeting of the Schenectady Section, American Institute of Electrical Engineers, on December 6, C. P. Steinmetz made an address on "Energy Loss Through Corona on Extra-High-Voltage Alternating-Current Lines." Both the theoretical and practical aspects of the subject were treated.

The Electrical Properties of Selenium.

At the recent Chicago meeting of the American Physical Society, two papers were read by F. C. Brown, of the State University of Iowa, dealing with the electrical properties of selenium, and a theory which would account for them. The papers, of which an abstract follows, dealt with both the light-positive and the light-negative varieties.

By light-positive selenium is meant that variety of selenium which increases its conductivity when it is illuminated. By light-negative selenium is meant that variety of selenium which decreases its conductivity when it is illuminated. The increase and decrease of conductivity of selenium by illumination are genuine changes in the selenium itself. The various conditions which change the conductivity of selenium were considered, such as light, mechanical pressure, electrical potential, temperature, moisture and radium, and it was pointed out that the experimental facts observed by different investigators seem to show only disagreement and confusion. The various observed properties of the light-positive and the light-negative selenium can be explained on the view that every light-sensitive variety of selenium contains one or all of three kinds of selenium, A, B, and C, which can coexist in various states of equilibrium depending on the quantities of A, B and C present and on the condition of light, pressure, temperature, etc. It is assumed that the A kind has zero conductivity, that the B kind has a specific conductivity approaching in magnitude that of the metals, and that the C kind has a specific conductivity between those of A and B. The light is supposed to act on the selenium so as to change A into B and B into C. This theory was elaborated by the author and shown to be in agreement with the observed facts in the following points: (1) The selenium of high sensibility is a light-positive variety and in the dark it is composed almost entirely of one kind, called A. (2) The light-positive selenium consists of various proportions of the A, B and C kinds. (3) The light-negative selenium, which decreases its conductivity from the instant it is illuminated, consists of various proportions of B and C in the dark. (4) The selenium whose conductivity first increases and then decreases with duration of illumination, consists of from one to ten per cent of the A kind, before exposure to light, and most of the remainder is of the B kind. Some instances show that the decrease of conductivity is greater than the increase. However the decrease is usually less than the increase. (5) In the Giltay selenium cell the maximum conductivity occurs more quickly with intense illumination than it does for weak illumination. (6) The curve for the conductivity of the A and B mixture at different times of exposure is convex upward before the maximum conductivity is reached and concave upward after the maximum is reached. (7) The specific conductivity of the light-negative selenium is extremely high, indicating a preponderance of the B kind. The author believes, in view of previous results and recent observations, that changes of A into B and of B into C are produced by mechanical pressure, electrical potential, temperature and other agencies, and that through selenium we shall be able to deduce quite directly fundamental relations existing between the units of these quantities. Even moisture by some mechanical means may change B into C. The recovery of selenium from light effects should be investigated from a similar viewpoint to the one here proposed for the original direct action of the light.

THE EFFECT OF TEMPERATURE ON THE ELECTRIC STRENGH OF PORCELAIN INSULATORS.[1]

BY GEORGE O. WEIMER.

This work was carried out by C. E. Henderson and the author with the object of determining the reason for the failure of insulators which had been subjected to unsually high temperature. The test pieces used were composed of twenty-seven per cent of Tennessee ball clay, number 7, six per cent of Tennessee ball clay, number 3. sixteen per cent of Georgia kaolin, sixteen per cent of American Eureka flint, and thirty-five per cent of American Eureka feldspar.

Two batches of two hundred pounds each of the above body were weighed and put into a ball mill, about two hundred pounds of water added, and the mass ground for an hour. The "slip" was then screened through a hundred-mesh sieve, and filter-pressed. This clay after being pugged in a small laboratory brick machine was put into stone jars of ten-gallons capacity each, covered with canvas, kept damp by occasionally sprinkling with water and allowed to age for about eight weeks. This clay has excellent working properties and a very low percentage loss in drying and burning as is shown by the following physical measurements: Drying shrinkage, 4.7 per cent; firing shrinkage, 11.0 per cent; absorption, 0.0 per cent.

Several attempts were made to make dies for forming the test pieces, but none of these proved practicable, so it was decided to shape the test pieces by jiggering. This involved the design and manufacture of a master mold, from which forty jigger molds were made. In forming the ware, a ball of the wedged clay was thrown forcibly into the mold and the crucible roughly shaped by means of a "jolly." A special tool was then employed to give the final form. These filled molds were placed in an oven to dry. As soon as the mold would deliver, the crucibles were removed and replaced in the oven to thoroughly dry. After drying they were "set" bottom down on a cushion of white glass sand, in special saggers. These saggers were placed in a coke-fired kiln and fired for about thirty hours, until a temperature of about 3,000 degrees was reached. The temperature was judged by means of Seger cones.

The testing was carried out by subjecting the specimen to puncturing voltage in an electrical furnace, or in an oil bath. The source of power was a high-tension transformer, rated at fifty kilowatts, 250,000 volts. The voltage was measured with an electrostatic voltmeter. Since little or no electromotive force is required to sustain an arc, the voltmeter reading dropped to zero upon puncturing, so by watching the voltmeter the voltage at the instant of puncture could be read. The electric furnace consists of a porcelain muffle, 3.5 inches in diameter, 9 inches in length, and 0.375 inch in thickness. This was wound with 0.375 pound of nichrome wire over which asbestos paste was plastered to a thickness of one inch. The furnace was connected to a supply of alternating current at 220 volts through rheostats which served to control the temperature.

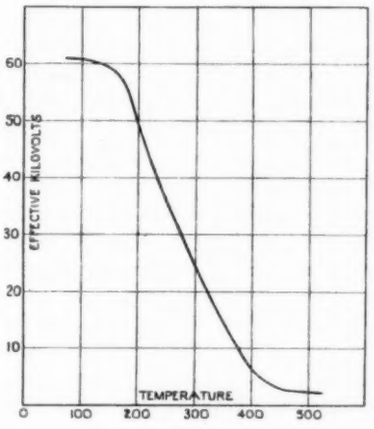


FIG. 1.

Two methods of testing were used, the furnace being used for the higher temperatures, while some of the work at low temperature was done under oil. In the latter case the test pieces were inserted between electrodes made of nichrome wire to prevent oxidation, and the whole apparatus submerged. As the oil did not permit of being heated higher than 250 degrees these results were not important, although it appeared that the breakdown voltage was decreasing as the temperature increased.

In using the electric furnace the test pieces were inserted and when the furnace had been heated to the required temperature the heating circuit was disconnected and the test circuit thrown in. The following table gives the results of the observations which have also been plotted in Fig. 1.

Temperature in degrees Fahrenheit.	Effective Volts.
75	60,700
125	60,100
175	57,300
225	42,500
275	30,250
325	19,750
375	10,500
425	4,000
475	2,500
525	2,000

It is seen that the electric strength decreases very slowly at first, but at about 150 degrees Fahrenheit, which appears to be a critical temperature, it begins to fall rapidly. This rapid decrease in strength continues to a temperature of about 425 degrees Fahrenheit, beyond which the strength appears to again become nearly constant. Upon retesting at room temperature a number of insulators which had previously been tested at a temperature higher than 400 degrees and presumably punctured, it was discovered that they had not been punctured but had no doubt begun to conduct electrolytically.

[1] Abstract of a paper read at the meeting of the American Physical Society, Chicago, November 26, 1910.

Indiana Traction Officials Make Test Run.

The officials of the Evansville and Southern Indiana Traction Company made a test run November 22 in a special car from Indianapolis to Princeton and return for the purpose of trying out the curves and roadbed recently ballasted.

In the car were William Murdock, president of the company; General Manager Durbin and Superintendent L. C. Shepherd, the latter having charge as motorman. The outgoing trip was made in fifty-five minutes.

The officials expressed themselves well pleased with the condition of the line and say they are confident the limited cars can make the run of twenty-nine miles in considerable less than an hour in perfect safety.

Railway Company Can Not Sell Power.

It was recently held by the Court of Appeals of Canada, that the Winnipeg Railway has no right to erect and maintain poles on the streets for any purposes not directly connected with the operation of the street-railway system. This guarantees a monopoly for the municipal plant.

Electrical Notes From Great Britain.

By Our British Correspondent.

The past month has been one of great activity and interest in most electrical circles, whether in London or the provincial centers. The various sections of the Institution of Electrical Engineers have all settled down to work in earnest with every prospect of a good winter session. London made an excellent start-off with a characteristically ingenious and prophetic address from the new president, S. Z. de Ferranti, which has set everybody thinking along more hopeful lines of the "all-electric" future of the British Isles. The attendance of members at the opening meeting was very large. The address of a president who appears to have a year of great popularity before him, and the experience of meeting for the first time in the new home of the institution, were special attractions.

The addresses that have just been delivered at several of the provincial sections of the Institution have also been of a high order. That of J. S. Peek to the Manchester meeting giving an account of the remarkble electrical progress of the United States, observed by him, an American, on the occasion of a recent visit, makes us all envious of your home market for electrical requirements when what we are in search of is a greatly increased output for our British electrical manufacturers whose tribulations seem to be incessant. At the Birmingham sectional meeting, M. J. Railing, who speaks as a representative of manufacturing interests, devoted his address to the paramount necessity of securing a constant flow of work for our electrical factories and workshops. The line of his argument may be gathered from this quotation: "Other countries have stolen a march on us, not so much in the production of engineers, nor yet in the production of purely commercial men, but in the development of a type of man who combines the qualities of both." Mr. Railing asks that the young British electrical engineer shall, like his confreres in competing countries, be encouraged to study, in addition to his own science, the technology of allied trades, and to train himself as well in languages, in commercial law, in natural economy, and in commercial routine generally. The address contained ideas of interest to any country engaged in electrical exportation, but in the main it may be regarded as an illustration of the greatly increasing attention which the British electrical manufacturer is devoting to foreign electrical trade as a means of enlarging the volume of manufactures, and thus doing something to improve prices, which still continue to be ridiculously low in Great Britain.

At the Newcastle-on-Tyne Section, C. Faraday Proctor devoted his address to the question of practical education. At Leeds Wilson Hartnell covered a variety of topics, including competition in manufacturing, manufacturing methods and costs, standardization, technical training, electrical distribution and coal conservation, high-voltage transmission, and other subjects. At Glasgow, Samuel Mavor's subject was power equipment of collieries. He said that electricity had been more serviceable to coal mining than to any other branch of industry, and great progress had resulted in recent years, but so far in the United Kingdom not much had been done in the direction of modernizing colliery power plants. The present extravagance in fuel consumption would, he remarked, be appalling were it not for the opportunity that it left for power engineers. Remembering important mining problems that have been very much under discussion here of late, Mr. Mavor said that in no department of electrical work was carelessness so dangerous, or were the benefits of thoroughness more apparent than in colliery work. Notwithstanding the advantages of electric hoisting, its high cost had prevented its adoption in the United Kingdom. The speaker expressed the view that a rich harvest was awaiting the man who could successfully pioneer turbo-compressors here.

At the Manchester meeting on November 22, and the London meeting two days later, Haydn T. Harrison's paper on "Street Lighting by Modern Electric Lamps" was considered. This paper in its earlier form had to be deferred owing to the death of King Edward.

It was mentioned here some months ago that Glasgow Corporation Electricity Supply Department was considering the whole question of charges to domestic consumers with a view to encouraging the use of electricity for cooking, heating, etc. W. W. Lackie, the city electrical engineer, has prepared a report on the subject and this has now been approved by a committee. He says that there would be no difficulty in giving a supply of energy for these purposes at a lower rate than is charged for lighting, but from the existing lighting circuits, thus avoiding the cost of extra wiring, by charging on an adaptation of the maximum-demand system. He anticipates as a result a considerable use of electricity for intermittent heating in spring, summer and autumn, when fires are seldom required, and when the Department has a good deal of plant unemployed so that heating units supplied at such a time at only two cents per unit would be profitable. An examination of domestic accounts for the past three years showed that they were practically stable from year to year, even in corresponding two-monthly periods. The domestic maximum demand averaged an 800 hours' use of the maximum demand per annum. At present such consumers pay a flat rate of six cents per unit. Mr. Lackie proposes a maximum demand rate of six cents per unit for 800 hours' use of the maximum demand, all consumed over this quantity to be charged at two cents per unit. The initial charge for the first 800 hours' use of the maximum demand will be on the principle of a proportionate number of six-cent units in each two-monthly account period, all over this quantity during that period being charged at two cents.

The question of charges to consumers has also formed the subject of a full report, containing three alternative schemes, at Sunderland. What is being aimed at here is to make a fixed charge per year to cover capital charges, with a low charge per unit to cover works' costs. The deliberations are in progress. The Newcastle-upon-Tyne Council, which has been charging twelve cents per unit net up to the

present, is now about to charge fourteen cents, with a new discount arrangement allowing two cents per unit off all accounts that are settled within four weeks.

The Stoke-on-Trent Electricity Department has issued a request to its power consumers that they shall do their utmost to lighten their motor supply demands between the hours of four and six p. m. in the winter months, these being the peak-load period.

A very full account of the equipment of the new power station and the several substations of the General Post Office, London, also particulars of the extensive electric lighting, ventilators, conveyors and elevators included in the installation of the King Edward's Building, which has just taken the place of the old public office in St. Martin's le Grand, was given before the Post Office Electrical Engineers' Society on November 14 by H. C. Gunton, who has had much to do with the carrying out of the work. The power-station equipment consists of Sterling-type boilers, two 1,000-kilowatt Willans-Dick-Kerr turbo-alternators running at 1,500 revolutions per minute, and one of 500 kilowatts, of the same type, running at 3,000 revolutions. This plant is situated at Blackfriars, on the bank of the Thames, and it generates a three-phase 6,600-volt, fifty-cycle current, which is conveyed by underground feeders to the substations, the chief of which contains four 300-kilowatt Bruce Peebles motor converters, a booster and a battery. In regard to the purposes for which these substations supply current, there are thirteen elevators supplied with a three-phase current at 440 volts, fifty cycles to the motors, and a direct current of 220 volts to operate the controllers. All the elevators, excepting three, run at 200 feet per minute with loads varying from 1,000 to 4,000 pounds. Seven are used for transferring mail matter and members of the postal staff. A five-ton elevator running at sixty feet per minute is used for transferring heavy cable drums between the basement and the yard level. All the elevators except one small service elevator, are drum driven. The motors, winding gear and controllers are in most cases placed in motor rooms in the basement, an arrangement which facilitates maintenance and reduces the cost of supply mains. There are three electrically driven bank conveyors for carrying mail bags; one for carrying baskets of letters, and one ropeway to carry baskets of letters placed in carriers. For the lighting of the buildings there are 2,384 metal-filament lamps of sixteen candlepower, 1,484 of 100 candlepower, also 572 of twenty-five and fifty, as well as sixty-one eight-candlepower carbon-filament lamps, and eighteen arc lamps. For the general lighting in the larger rooms and offices, groups of three fifty, three one-hundred, and four one-hundred candlepower lamps are used as space demands, in order to provide for an illumination of from two to three candle-feet at surfaces where work is done in the sorting offices, and one to two candle-feet where the duties performed are purely clerical. The arc lamps are for the illumination of the Post Office yard.

On November 18 L. A. Legros brought before the Institution of Mechanical Engineers in London a useful review of the development of road locomotion in recent years. In some sections he dealt with motor omnibuses, electric tramways and electric railless cars.

ALBERT H. BRIDGE.

London, November, 1910.

A Primary Cell Sensitive to Light.

In a paper presented to the French Academy of Science, M. H. Pelabon shows some remarkable effects which the action of light produces upon an electrolytic cell composed of antimony and selenide of antimony. This is different from what occurs in a selenium cell. If we place two rods in a solution of trichloride of antimony in hydrochloric acid, one rod being of pure antimony and the second of an antimony and selenium alloy, we have an electrolytic cell in which the pure metal forms the negative pole. Such cells have curious properties. When the cell is kept in the dark the electromotive force on open circuit takes a fixed value after a few days, providing the temperature does not change. This electromotive force we may call (I). By suddenly lighting the positive electrode, the electromotive force rises immediately and takes a value (II). Keeping the light on all the while, the electromotive force now diminishes spontaneously, and, after a certain time, say twenty minutes, it reaches the initial electromotive force (I), and after three hours' lighting this remains the same. When the light is cut off the electromotive force lessens and takes a value (III), then it increases slowly and takes more than one hour to reach the initial value (I). This it keeps as long as it remains in the dark.

In several experiments, using an electrode of four parts antimony and one selenium, the electrode of the cell was lighted by an opening in the wooden protecting case by an incandescent lamp placed fifteen centimeters from the electrode. The terminals of the pile are platinum wires soldered to the electrode. Lighting the positive electrode, the electromotive force rises at once from 0.0559 volt to a value (II) higher than 0.0789 volt. It then falls to the initial value while still lighted. Cutting off the light, the electromotive force falls to a value lower than 0.0359 volt, coming back to the original value after a time. In both cases the variation is almost half the initial electromotive force. These values apply to open circuit.

For closed circuit the electromotive force has greater variations. At rest and in the dark the initial electromotive force (1) is lower than that of open circuit (I). On lighting, the electromotive force rises to a value (2) and then drops to a new value (3), which is larger than (1). Suppressing the light, the electromotive force falls at once and reaches a value (4) lower than (1). Then it increases and reaches the initial point.

The following experiments were made with a pile having a positive electrode of the composition ninety-nine parts antimony and one part selenium; the temperature at the start is 16.5 degrees centigrade. Light from a Nernst lamp was thrown on the positive electrode by a lens. The electromotive force on open circuit is 0.0424 volt in the dark. Working now on closed circuit, it becomes 0.0135. Lighting the cell, the electromotive force takes the value 0.0780 volt, or nearly six times the initial, then drops to a new constant value of 0.0245 volt. This result is explained by the rise of temperature of the cell. Cutting off the light, the electromotive force becomes 0.0024 volt. The same phenomena are observed for all compositions of the positive electrode.

No effect is obtained when one substitutes tellurium or sulphur for the selenium.

TEST OF A 15,000-KILOWATT STEAM-ENGINE-TURBINE UNIT.

REMARKABLE EFFICIENCIES ARE OBTAINED BY COUPLING A LOW-PRESSURE TURBINE TO A RECIPROCATING-ENGINE INSTALLATION.

The recent developments in low-pressure turbine design, due in no small measure to the improvements in condenser practice, have led to remarkable economies when these units have been added to existing reciprocating-steam-engine plants, especially when the latter have hitherto been operated noncondensing. A noteworthy contribution to the literature on this subject was made by H. G. Stott and R. J. S. Pigott in a paper entitled "Test of a 15,000-Kilowatt Steam-Engine-Turbine Unit," presented at a meeting of the American Society of Mechanical Engineers, in New York city.

Instead of inserting in the paper the enormous accumulation of data incident to the tests, the authors divided their paper into two parts. The first part of the paper consisted of a text which is substantially reproduced below. The second part included all the principal data acquired during the tests, with sufficient explanation to make their meaning clear without reference to the text.

The tables and curve sheets were as follows:

Series A.—Engine tests made in connection with acceptance tests, and also later to determine best conditions for operation.

Series B.—Calculations and data furnished by turbine manufacturer to determine probable results when combined with engine data in Series A.

Series C.—Tests on No. 1 combined unit.

Series D.—Tests of No. 2 unit.

Series E and F.—Tests on No. 2 combined unit. Conditions of vacuum and quality of steam entering the turbine are nearly standard, so that corrections are small. Several of the curves obtained by the authors from these series are reproduced in the following, which is from the text of the paper.

During the year 1908 it became apparent that owing to the cost increasing traffic in the New York subway, it would be necessary to have additional power available for the winter of 1909-1910.

The power plant of the Interborough Rapid Transit Company, which supplies the subway, is located on the block bounded by Fifty-eighth and Fifty-ninth Streets, and by Eleventh and Twelfth Avenues, adjacent to the North River. It contains nine 7,500-kilowatt (maximum rating) engine units, besides three 1,250-kilowatt sixty-cycle turbine units which are used exclusively for lighting and signal purposes.

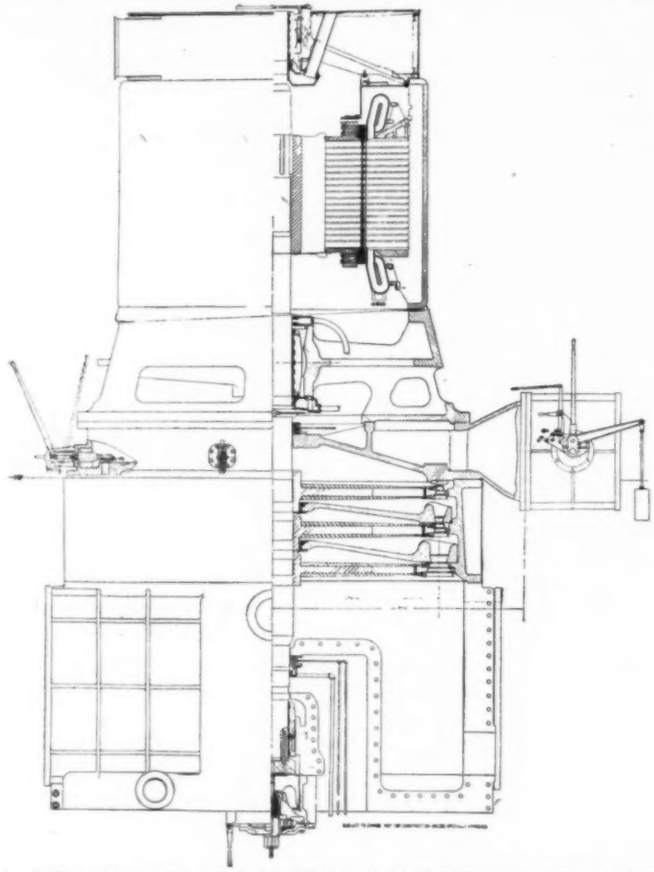


FIG. 1.—ELEVATION AND PART SECTION OF LOW-PRESSURE TURBINE UNIT.

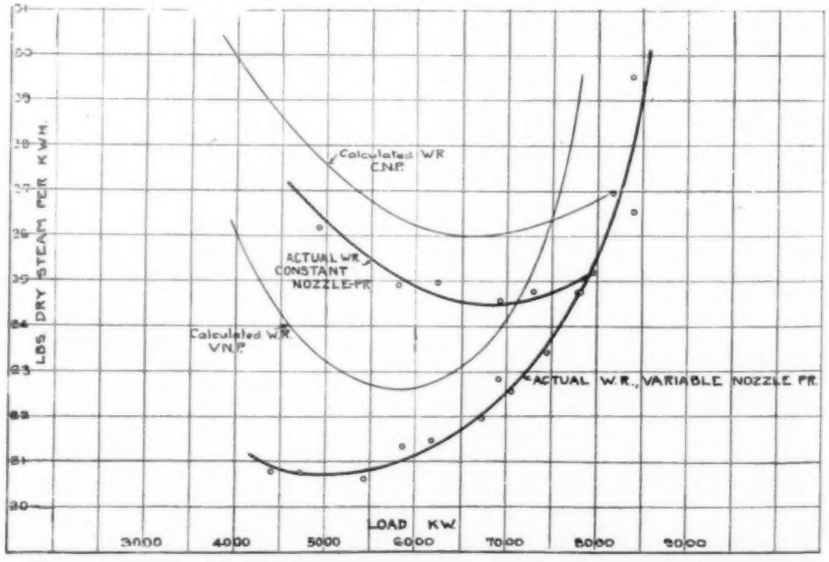


FIG. 2.—RESULTS OF TESTS, SERIES E AND F.—VARIATION OF ENGINE WATER-RATE WITH ENGINE LOAD.

The 7,500-kilowatt units consist of Manhattan-type compound Corliss engines, having two forty-two-inch horizontal high-pressure cylinders and two eighty-six-inch vertical low-pressure cylinders. Each horizontal high-pressure cylinder and vertical low-pressure cylinder has its connecting rod attached to the same crank, so that the unit becomes a four-cylinder sixty-inch-stroke compound engine with an overhanging crank on each side of a 7,500-kilowatt (maximum rating), 11,000-volt, three-phase, twenty-five-cycle generator. The generator revolving field is built up of riveted steel plates of sufficient weight to act as a flywheel for the two engines connected to it. This arrangement gives a very compact two-bearing unit. The valve gear on the high-pressure cylinders is of the poppet type, and on the low-pressure of the Corliss double-ported type.

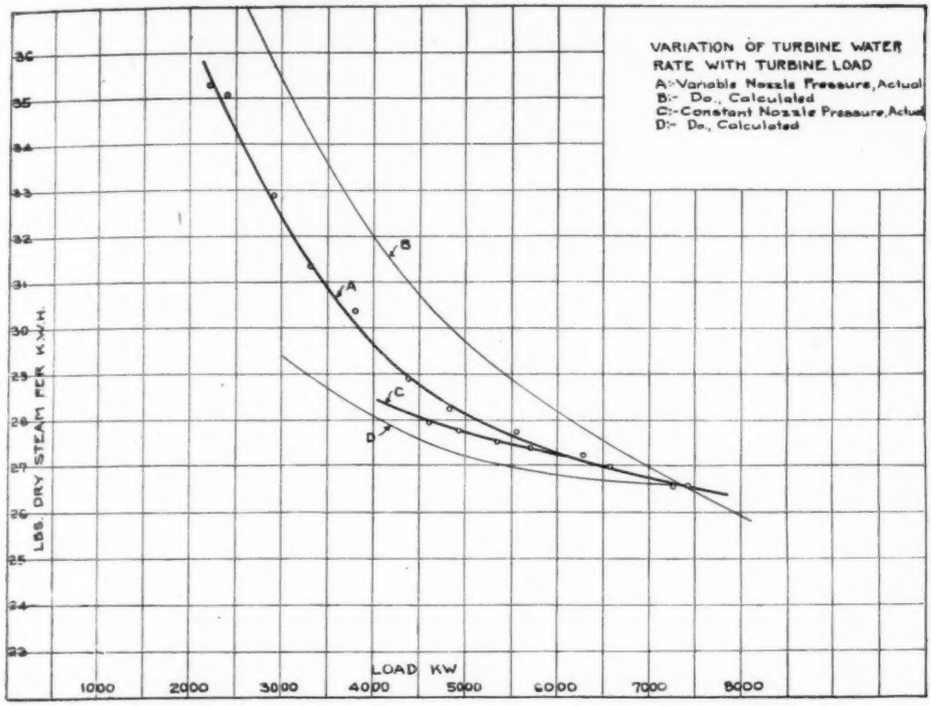


FIG. 3.—RESULTS OF TESTS, SERIES E AND F.—VARIATION OF TURBINE WATER-RATE WITH TURBINE LOAD.

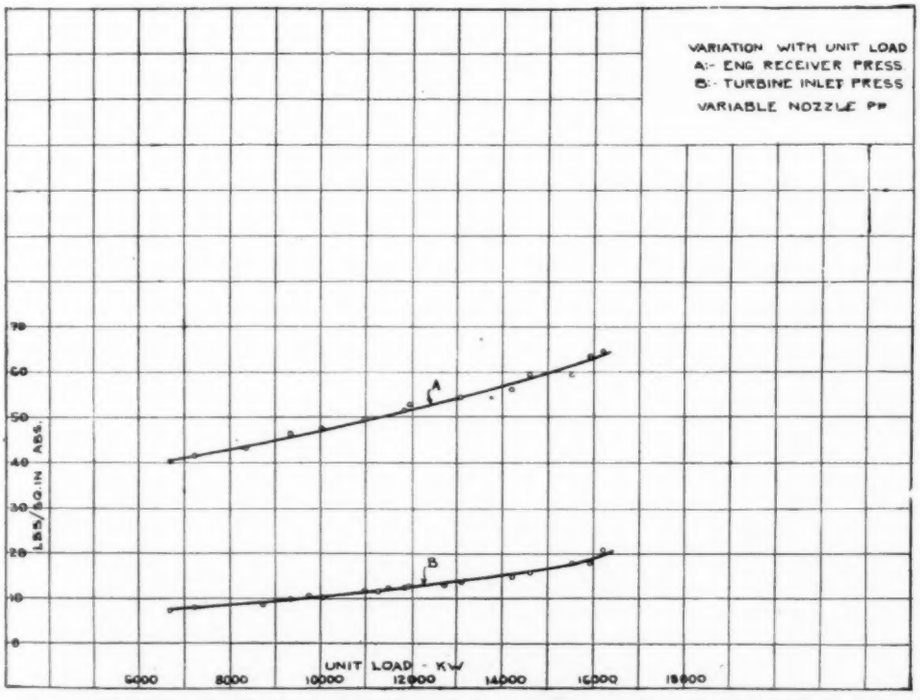


FIG. 4.—RESULTS OF TESTS, SERIES E AND F.—VARIATION OF ENGINE-RECEIVER PRESSURE AND OF TURBINE INLET PRESSURE WITH UNIT LOAD.

The condensing apparatus consists of barometric condensers, arranged so as to be directly attached to the low-pressure exhaust nozzles, with the usual compound displacement circulating pump and simple dry-vacuum pump.

These engine and generator units are in general probably the most satisfactory large units ever built, as five years' experience with them has proved. Their normal economic rating is 5,000 kilowatts, but they operate equally well (water rate excepted) on 8,000 kilowatts continuously.

In considering the problem of how to get an additional supply of power, every available source was considered, but by a process of elimination only two distinct plans were left in the field.

The electric transmission of power from a hydraulic plant was first considered, but owing to the high cost of a double transmission line from the nearest available water power, and the impossibility of getting reliable service (that is, service having a maximum total interruption of not more than ten minutes per annum) from such a line, further consideration of this plan was abandoned.

The gas engine, while offering the highest thermodynamic efficiency at the same time required an investment of at least thirty-five per cent more than an ordinary steam-turbine plant with a probable maintenance and operation account of from four to ten times that of the steam turbine.

The reciprocating-engine unit of the same type as those already installed

was rejected in spite of its most satisfactory performance, on account of the high first cost and small range of economical operation. The economic limits of operation are between 3,300 kilowatts and 6,300 kilowatts; beyond these limits the water rate rises so rapidly as to make operation undesirable under this condition, except for a short period during peak loads.

The choice was thus narrowed down to either the high-pressure steam turbine or the low-pressure steam turbine. There was sufficient space in the present building to accommodate three 7,500-kilowatt units of the high-pressure type, or a low-pressure unit of the same size on each of the nine engines, so that the question of real estate and building were eliminated from the problem.

The first cost of a low-pressure turbine unit is slightly lower than that of a high-pressure unit, due to the omission of the high-pressure stages and the hydraulic governing apparatus but the cost of the condensing apparatus would be the same in both cases. The foundations and the steam piping in both cases would not differ greatly. The economic results, so far as the first cost is concerned, would then be approximately the same, if we consider the general case only; but in this particular instance the installation of high-pressure turbines would have meant a much greater investment for foundations, flooring, switchboard apparatus, steam piping and water tunnels, amounting to an addition of not less than twenty-five per cent to the first cost.

The general case of displacing reciprocating engines and installing steam-turbine units in their place was also considered. The best type of high-pressure turbine plant has a thermal efficiency approximately ten per cent better than the best reciprocating-engine plant, but the items of labor for operation and for maintenance, together with the saving of about eighty-five per cent of the water for boiler-feed purposes and the ten per cent of coal, reduce the relative operating and maintenance charges for the steam-turbine plant to eighty per cent, as compared to 100 per cent for the reciprocating-engine plant, a difference of twenty per cent.

Assuming that the reciprocating-engine plant is a first-class one and has been well maintained, about twenty per cent of its original cost (for engines, generators and condensers) may be real-

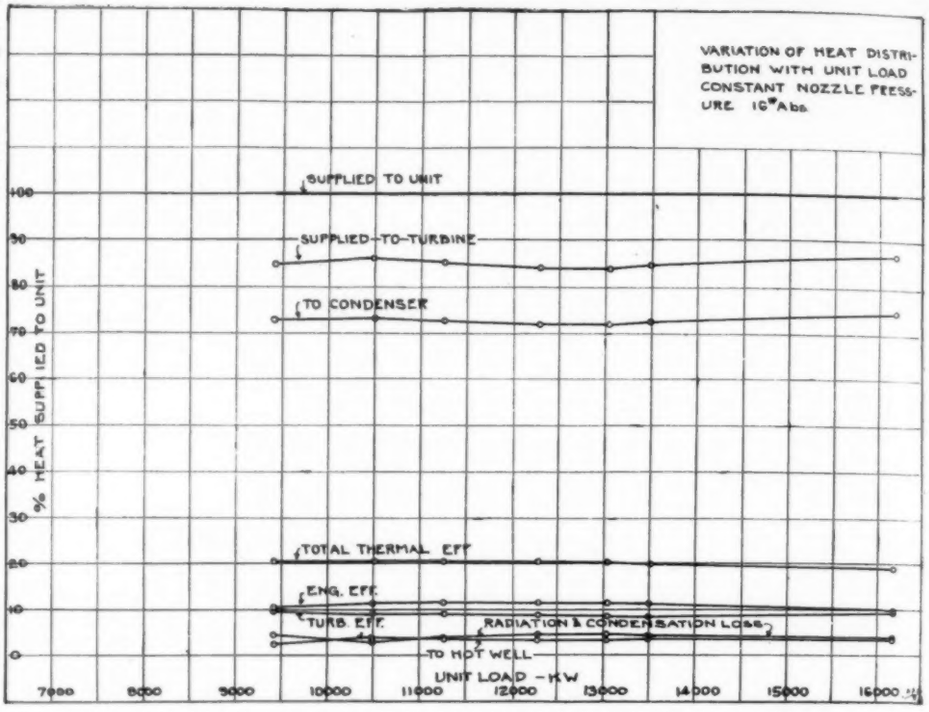


FIG. 5.—RESULTS OF TESTS, SERIES E.—VARIATION OF HEAT DISTRIBUTION WITH UNIT LOAD, CONSTANT NOZZLE PRESSURE.

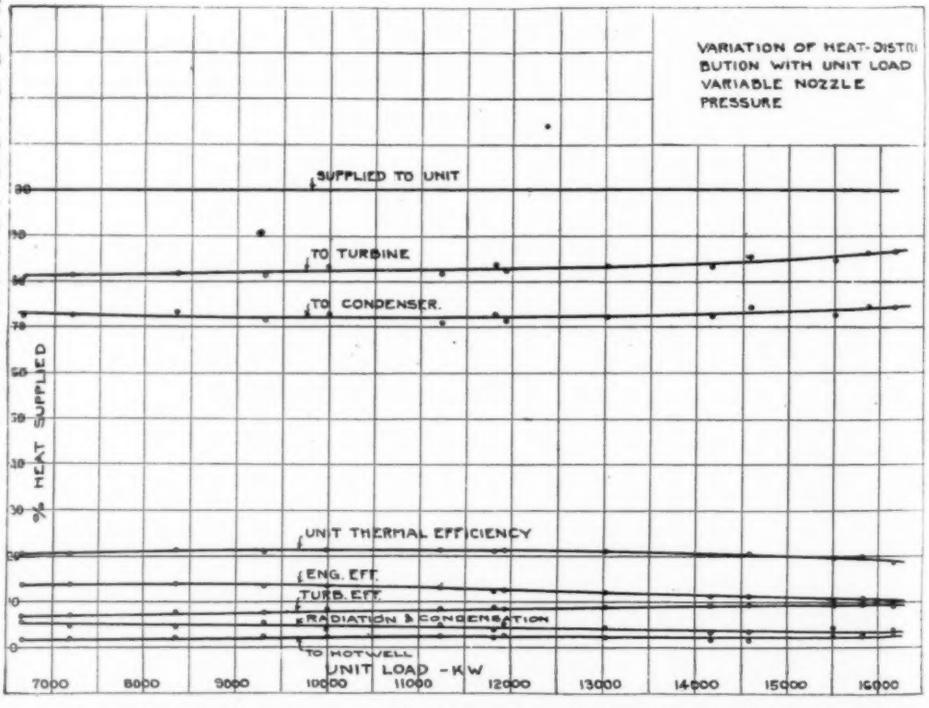


FIG. 6.—RESULTS OF TESTS, SERIES F.—VARIATION OF HEAT DISTRIBUTION WITH UNIT LOAD VARIABLE NOZZLE PRESSURE.

ized on the old plant and so credited to the cost of the high-pressure turbine plant. But on the other hand, if the high-pressure turbine installation is to receive credit for the second-hand value of the engines, it must also have a debit charge for 100 per cent of the original reciprocating-engine plant which it displaced. The relative investments, therefore, upon this basis would be approximately equal for the high-pressure or the low-pressure turbine; but eighty per cent of the cost of the original engine plant would have to be charged against the high-pressure turbine plant, as against an actual increase in value (to the owner) of the engine by reason of its improved thermal efficiency, due to the addition of the low-pressure turbine.

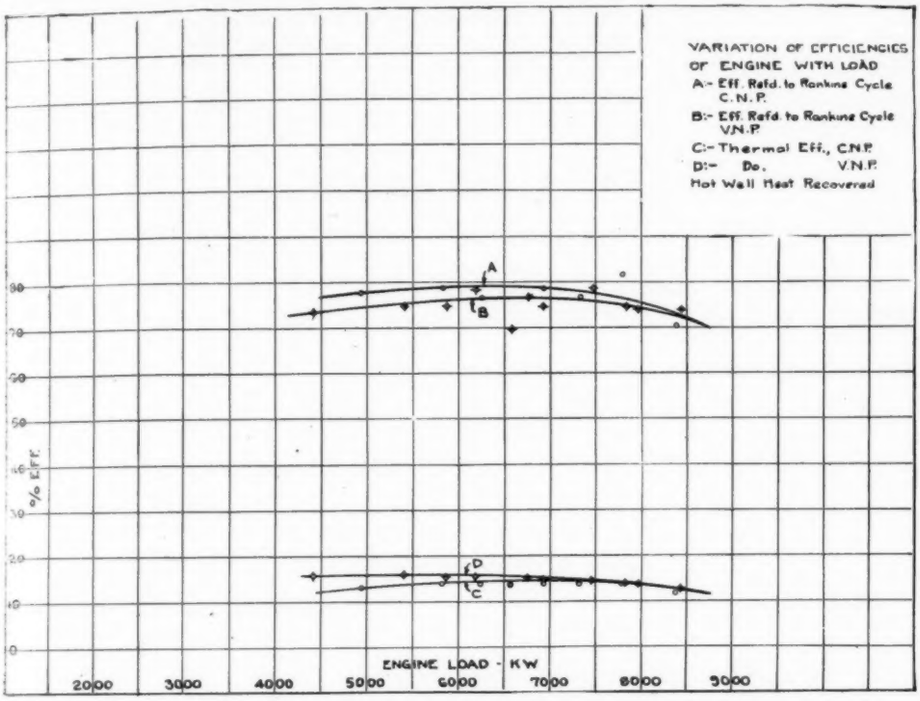


FIG. 7.—RESULTS OF TESTS, SERIES E AND F.—VARIATION OF EFFICIENCIES OF ENGINE WITH LOAD.

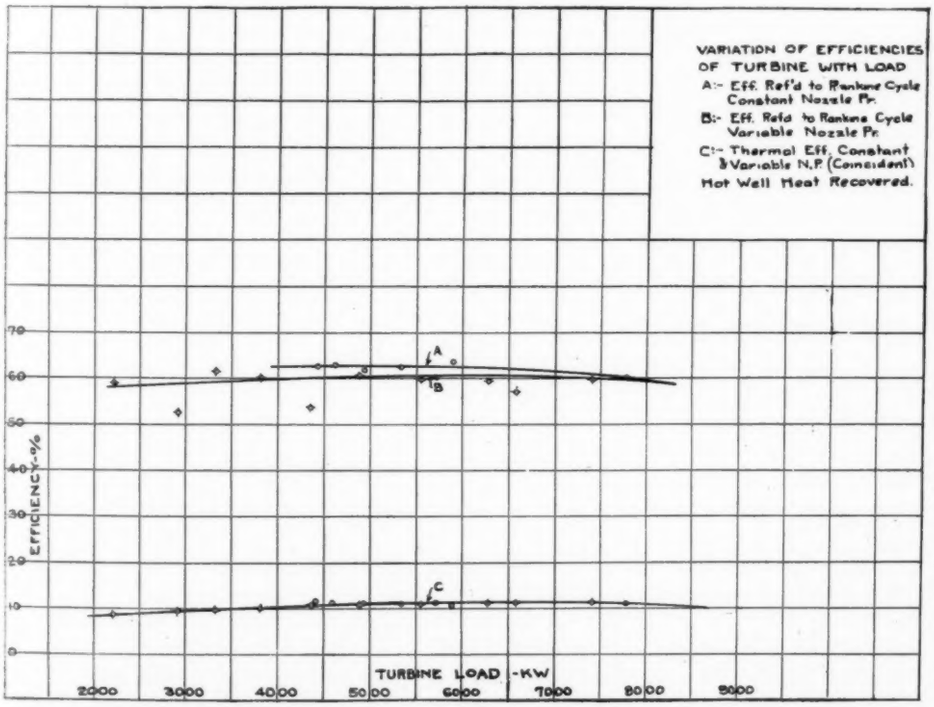


FIG. 8.—RESULTS OF TESTS, SERIES E AND F.—VARIATION OF EFFICIENCIES OF TURBINE WITH LOAD.

The turbine installed (see Fig. 1) is of the vertical three-stage impulse type having six fixed nozzles and six which can be operated by hand, so as to control the back pressure on the engine, or the division of load between engine and turbine. An emergency overspeed governor, which trips a forty-inch butterfly valve on the steam pipe connecting the separator and the turbine and at the same time the eight-inch vacuum breaker on the condenser, is the only form of governor used. The footstep bearing, carrying the weight of the turbine and generator rotors, is of the usual design supplied with oil under a pressure of 600 pounds per square inch with the usual double system of supply and accumulator to regulate the pressure and speed of the oil pumps.

The condenser contains approximately 25,000 square feet of cooling surface arranged in the double two-pass system of water circulation with a thirty-inch centrifugal circulating pump having a maximum capacity of 30,000 gallons per hour. The dry vacuum pump is

The preliminary calculations, based upon the manufacturers' guarantees for the low-pressure and high-pressure turbines, showed that the combined engine-turbine unit would give at least eight per cent better efficiency than the high-pressure turbine unit, so that it was finally decided to place an order for one 7,500-kilowatt (maximum rating) unit, as by this means we would not only get an increase of 100 per cent in capacity, but at the same time give the engines a new lease of life by bringing them up to a thermal efficiency higher than that attained by any other type of steam plant.

of the single-stage type, twelve inches and twenty-nine inches by twenty-four inches, fitted with Corliss valves on the air cylinder. The whole condensing plant is capable of maintaining a vacuum within 1.1 inches of the barometer when condensing 150,000 pounds of steam per hour when supplied with circulating water at 70 degrees Fahrenheit.

The electric generator is of the three-phase induction type, star-wound for 11,000 volts, 25 cycles and a speed of 750 revolutions per minute. The rotor is of the squirrel-cage type with bar winding connecting into common busbar straps at each end. This type of generator was chosen as being specially suited to the conditions obtaining in the plant.

With nine units operating in multiple, each one capable of giving out 15,000 kilowatts for a short time, operating in multiple with another plant of the same size, it is evident that it is quite possible to concentrate 270,000 kilowatts on a short-circuit. If we proceed to add to this synchronous turbine units of 7,500 kilowatts capacity which, owing to their inherently better regulation and enormous stored energy, are capable of giving out at least six times their maximum rated capacity, the situation might soon become dangerous to operate, as it would be impossible to design switching apparatus which could successfully handle this amount of energy. The induction generator, on the other hand, is entirely dependent upon the synchronous apparatus for its excitation, and in case of a short-circuit on the busbars would automatically lose its excitation by the fall in potential on the synchronous apparatus.

The absence of fields leads to the simplest possible switching apparatus, as the induction-generator leads are tied in solidity through knife switches, which are never opened, to the main generator leads. The switchboard operator has no control whatever over the induction generator, and only knows it is present by the increased output on the engine generator instruments.

The method of starting is simplicity itself—the exciting current is put on the engine generator before starting the engine, and then the engine is started, brought up to speed and synchronized in exactly the same way as before. While starting in this way the induction generator acts as a motor until sufficient steam passes through the engine to carry the turbine above synchronism, when it immediately becomes a generator and picks up the load. Three of these 7,500-kilowatt low-pressure turbine units have been installed and tests run on Nos. 1 and 2. No. 3, having been just started, has not yet been tested.

In all results, except where specially noted, moisture corrections are simple corrections, *i. e.*, for each per cent of moisture only one per cent correction has been made. Vacuum corrections for the combined unit are one pound for each inch variation from 28.5 inches when referred to 29.92 inches barometer.

The net results obtained by the installation of low-pressure turbine units may be summarized as follows:

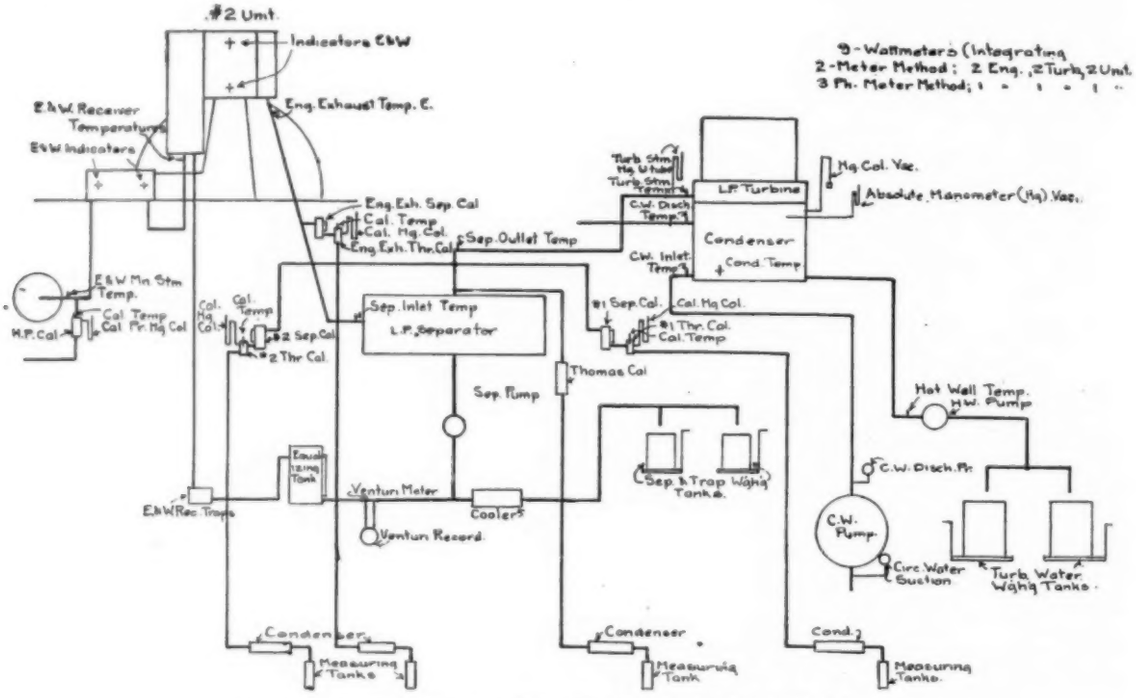


FIG. 9.—DIAGRAMMATIC LAYOUT FOR TESTS, SERIES E AND F.

(*a*) An increase of 100 per cent in maximum capacity of plant.

(*b*) An increase of 146 per cent in economic capacity of plant.

(*c*) A saving of approximately 85 per cent of the condensed steam for return to the boilers.

(*d*) An average improvement in economy of 13 per cent over the best high-pressure turbine results.

(*e*) An average improvement in economy of 245 per cent (between the limits of 7,000 kilowatts and 15,000 kilowatts) over the results obtained by the engine units alone.

(*f*) An average unit thermal efficiency between the limits of 6,500 kilowatts and 15,500 kilowatts of 20.6 per cent.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

ELEMENTS OF POWER-STATION DESIGN.—XV.

UNDERGROUND TRANSMISSION.

BY W. B. GUMP.

Ventilation.—The ventilation of manholes and duct systems in general is usually very poor. Little or no attention is given to this matter, and when workmen are operating in these places the true condition is fully realized. Those in authority seldom bother with this question as long as the system is working, and are not apt to appreciate the advantage of caring for the comfort of the employees or the efficiency to be derived from a first-class installation.

It is quite true that the problem of ventilation offers serious difficulties. There is no good excuse for ignoring so important a question, but rather a reason why close study and effort should be given to its solution. The usual provision for ventilating manholes is to have a number of holes in the iron cover, allowing the heat which rises to escape. Where there are good sewer connections to take care of heavy rains this means of ventilating is not objectionable, except in the case of very large systems having heavily loaded cables, in which case the accumulation of heat is disastrous, and some form of forced ventilation should be adopted. Forced ventilation may be effected by using fan motors in the manholes. These motors could be connected with a thermostat, which would actuate the fan when a definite temperature was reached. In this way the motors would not be required to operate incessantly.

Natural ventilation could be had through pipes leading to the sidewalk above the highest storm drain. Such an arrangement has the disadvantage of demanding special construction, and is consequently more costly than standard types. It is adopted in several large systems.

Where no connection can be had to a sewer it is necessary to close the manhole with a water-tight cover. For this reason no ventilation is provided, and care must be exercised in determining the number of cables and the load to be carried. Tightly closed manholes are to be avoided, except where such construction is absolutely necessary, in which case the number of cables installed must be reduced considerably below the number otherwise permissible.

In addition to the air in manholes there are gases which accumulate, and in case no vent is afforded explosions may occur. The danger of explosions is greatly multiplied in manholes and in tunnels carrying both electric cables and gas mains, since the gas leaking from these pipes will readily ignite in case of overheating or burning out of a cable, or from mere contact with live conductors.

Installation of Cables.—The efficiency of operation and the permanency of electric cables depend very largely upon the manner in which they are installed. In fact, many faults, revealed after cables are in service, are directly attributable to inefficient workmanship during installation.

When ordering cable it is necessary to specify the exact lengths suitable for respective distances between manholes, allowing a certain number of feet per length for drawing in. One of the most important points to be respected is provision against moisture. If great care is not exercised, especially where water has accumulated in ducts and manholes, the cable is sure to break down near the ends, after being put in service. The precaution to be taken is to cut off several feet of cable (that is, the necessary portion to remove all moisture) before making final connections. If it becomes necessary to have any of the cables idle for a considerable time before being connected, the ends should be wiped over and made water-tight.

In drawing in lengths of cable exceeding about 500 feet it is customary to employ some form of capstan or a block and tackle. In very large cities electric trucks are employed to transport reels of cable to the manholes. These trucks are generally equipped with a windlass for drawing in the cable, and it may be said that this method of installing has proven to be highly satisfactory, and is cheaper than the other methods mentioned. This assumes, of course, that the company has a large business and is warranted in employing electric trucks.

Where it is desired to fireproof the cables in manholes which are crowded (such as those of older construction) a wrapping can be given, consisting of asbestos strips soaked in a strong solution of silicate of soda. This becomes hard when dry, and prevents the spreading of fire caused by a ground or short-circuit. For additional protection a metallic covering may be applied over the asbestos, in which case the latter may be put on dry.

Junction Boxes and Terminals.—Junction boxes and services boxes should be made water-tight, either by wiped connections or stuffing boxes. The former is preferable. Gaskets usually provided with the cast-iron boxes are satisfactory for the covers when the bolts are tightly drawn. It is best to locate these boxes at a point well above the floor of the manhole, and in a position which is thoroughly accessible. A definite system of labeling terminal connections and busbars is not only advisable but necessary if reliable service is desired. Steel punch marks afford a reliable means of identification of busbars and terminals, as these marks are more permanent than paper tags. Substantial cloth tags can generally be used to advantage in identifying cables.

It is usual in bringing cables out of a manhole for distribution overhead to carry them through iron conduit to the curb line, and up the pole to a distance

of ten to twenty feet, the cables extending up to one of the cross arms, and there terminating in a pothead, from which the individual lines run out to insulators. Where pole lines are not used service boxes can be installed in the basements of respective customers' installations, power being distributed directly from manholes.

The cable sheaths should be effectively grounded to prevent static induction. Where cables are supported directly upon iron racks it is well to make a good ground connection to these racks, for the reason that stray currents are apt to circulate between the cables when there is a difference of potential between racks. As it is not good practice to carry lead-covered cables directly in contact with iron brackets the protective covering over the lead sheath would ordinarily take care of stray currents. A permanent ground, however, is advisable in nearly all installations.

Potheads or terminal bells should be constructed to suit the local environment. Those used on pole tops are usually protected from rain and moisture by a metal hood supported above the bell, and having a diameter enough larger than the bell to accommodate outgoing lines and shed all water striking the cover.

Manhole and Subway Transformers.—It is often necessary to install distributing transformers in subways and manholes. The most serious danger to be met is that of flooding. Two precautions, at least, must be taken. The first is to locate the transformer above the floor, choosing the driest place to be found. The second is to provide a water-tight transformer. These transformers, being of the oil-filled type, are subject to internal pressure when overloaded, due to expansion of the oil, and the air in the space above. Hence, some form of relief valve should be connected to the transformer case to prevent abnormal pressure.

The protection of the primary fuses is of vital importance, and where a subway or manhole is not perfectly dry, these fuses must be amply protected against water, dirt and all other foreign matter.

Lighting of Manholes and Subways.—When designing underground systems the importance of properly lighting the manholes must be considered. It is always advisable to install extra conduits for lighting circuits. The lighting circuits should be kept clear of all power circuits. In order to afford first-class protection to lighting circuits the wiring is best completely inclosed in iron conduit. The wiring of a manhole should be carried out in the same manner as the lighting of any basement room in which provision is made against moisture. In too many systems this feature is so neglected as to greatly hamper facilities for proper inspection and repairs.

It will generally be found feasible to carry the lighting conduit along the topmost portion of the manhole, in this way keeping the lighting circuit completely segregated from all cables, and insuring proof against moisture. Switch and fuse boxes in manholes are to be inclosed with water-tight covers, the same as other parts of the wiring, regardless of location in the manhole.

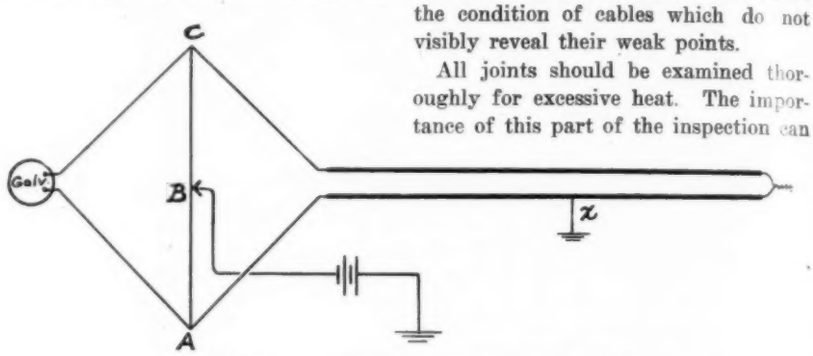


FIG. 5.—DIAGRAM OF CONNECTIONS FOR LOOP TEST.

Operation and Maintenance.—When properly installed, underground transmission systems give less trouble than overhead systems, provided that these systems are given due care. No electrical system is entirely free from trouble, and an underground system is subject to certain interruptions, even under the best management, since chances for trouble always exist in the vicinity of conductors conveying electricity.

The object which should be foremost in connection with an electric power system is to minimize these troubles. This can only be done by regularly inspecting every part of the system, cleaning the manholes, and reporting portions which show any sign of trouble. Junction boxes, fuse boxes and all like portions should be opened at definite intervals, and thoroughly cleaned. Frequent tests should be made to determine the condition of cables which do not visibly reveal their weak points.

All joints should be examined thoroughly for excessive heat. The importance of this part of the inspection can hardly be overestimated, as much of the trouble arising in underground systems is directly traceable to defective joints. The temperature of cables, joints and the various parts of the cable system should be accurately measured, since this will be a true indicator of the amount of overload, if any.

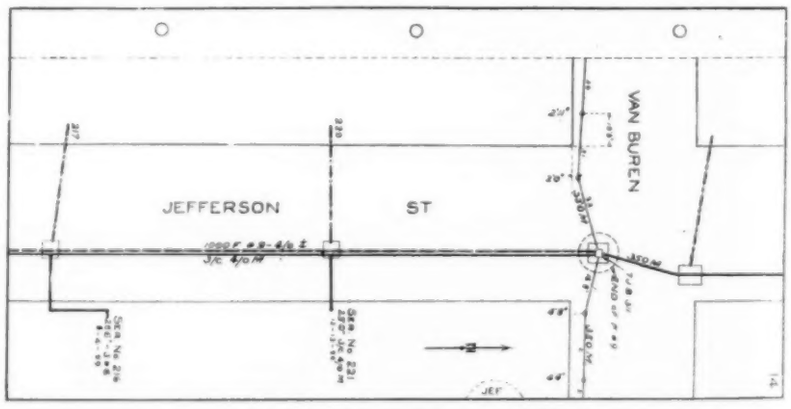


FIG. 6.—RECORD OF UNDERGROUND SYSTEM.

Regular inspection may be looked upon as "an ounce of prevention," although, unfortunately, it is not generally so regarded. When neglect in this respect exists the inevitable "pound of cure" must follow, which is always both expensive and annoying.

Locating Faults.—The difficulties con-

fronted in locating trouble in underground systems increase with their magnitude. Quite a number of methods of testing for faults have been employed, including the "loop" or bridge test, which is quite common. This test is applicable to lines where two conductors are available. Where the breakdown occurs at more than one point this method is not satisfactory. Neither is it reliable when there is a high resistance at the point of breakdown, since the resistance of the fault itself is considered negligible.

The method of connections are shown in Fig. 5, in which the equations are:

$$\frac{AB}{BC} = \frac{AX}{CX}$$

Since $CX = L - AX$, the equation becomes

$$\frac{AB}{BC} = \frac{AX}{L - AX}$$

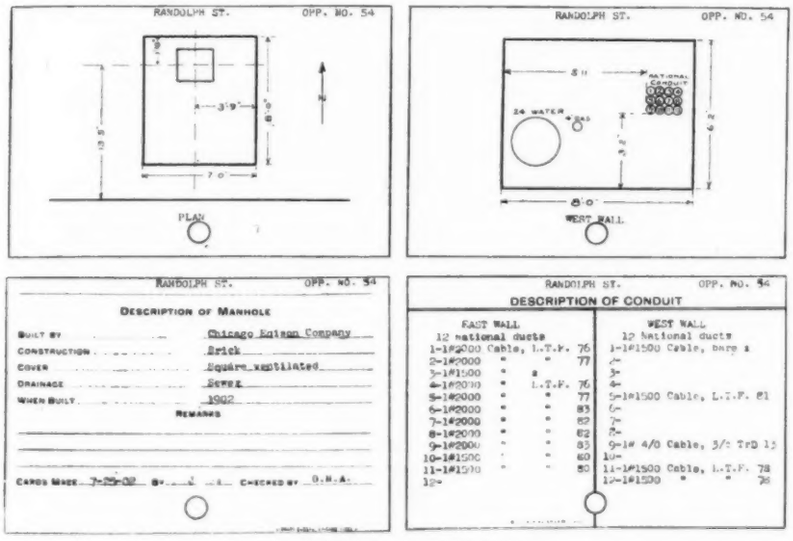


FIG. 7.—RECORD OF MANHOLES.

$$AX = \frac{AB\,(L - AX)}{BC}$$

$$= \frac{AB \cdot L}{AB + BC}$$

Under usual conditions the method described will give satisfaction in locating a fault within about two hundred feet in a distance of five miles. Since the trouble is more frequently in a manhole than in the ducts, the exact location is readily determined.

Keeping of Records.—Complete records are essential to the successful operation of any underground system, not to mention their utility in the case of all other systems of electric transmission. These records must include every detail of the system, as originally installed, and the extensions added from time to time.

A card-index method is to be recommended as being the most simple and complete. Office records should be kept in a manner similar to that of Figs. 6 and 7 which shows at a glance the details of installation for a given territory. On account of the number of details in the way of junction boxes, service boxes, switches, fuses, branch blocks, etc., it will often simplify the records to use symbols, especially in recording the individual appliances of each consumer. It is not the intention here to take up this feature at length since it deals more particularly with the organization than with the technical side. The former is taken up in a succeeding chapter.

(To be Continued.)

[EDITOR'S NOTE.—This important series of articles started in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, September 3, 1910, and will cover every phase of central-station design. The treatment is elementary and withal practical throughout, and the complete series will constitute a standard and reliable treatise on this important subject.]

Ohio Society to Meet at Youngstown.

The next convention of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held at Youngstown, O., on May 18-19. This was decided at the Springfield meeting which was held recently. The following officers were chosen at that meeting: President, Oscar S. Rabbe, Toledo; vice-president, H. L. Patterson, Youngstown; managers, John J. Hoppes and Daniel Delaney.

High-Voltage Transmission in Germany.

A 110,000-volt transmission system is being constructed in connection with a plant at Lauchhammer, Germany, in which three turbo-generators of 5,000-kilowatts capacity each are now being installed. This will be the highest voltage used for transmission work in Europe. The voltage will be stepped up from 5,500 volts by means of three-phase oil-cooled transformers, each having a capacity of 6,800 kilovolt-amperes.

The Aktien-Gesellschaft Lauchhammer owns a considerable number of iron and steel works. Each of these works has until now been provided with an individual power plant. It was found that the Lauchhammer works lay over an extensive deposit of lignite and plans were provided for utilizing this cheap but low-grade fuel in the generation of electricity on a large enough scale so that power for the other works of the company could be supplied from the one plant.

The final capacity of the plant as projected is about 50,000 horsepower. Two transmission lines, each about thirty-one miles, carry the high-tension current to substations at Gröditz and Riesa.

Economy of Long-Distance Stations.

The following table, from the London *Electrical Engineer*, is based on the statistics of fifty-six German central stations of which fifteen supply current for agriculture only, eighteen for manufacturing purposes only, and the remainder for both purposes:

Current Used—	Cost of installation per KWH supplied.	Cost of installation per KW generated.	Yearly output; maximum load.
For manufacturing purposes	$0.16	$249.40	2,445
For agricultural purposes	.95	490.40	1,127
For both of these purposes	.39	321.60	1,770

This shows, says our contemporary, the very bad position of the centers supplying current for agricultural purposes only in very convincing fashion. Five methods are to be recommended for improving the situation:

(1) Making the area served as large as possible.

(2) Obtaining the current by water-power.

(3) Enlisting the sympathy or co-operation of public bodies.

(4) Renunciation of profit on the part of credit givers.

(5) Turning over the concern for a term of years to private management.

ELECTRICAL Advertising *and* Selling

Electric Vehicle Development in Chicago.

Comparatively few people realize what wonderful progress in the development of the electrical vehicle has been made in the past few years. Possibly there has been nothing more satisfactory, from the electrical standpoint, than this development of the electric vehicle and power wagon for the convenience of luxurious traveling and for the absolute hard and fast saving of money necessitated by the ever increasing competition of modern business conditions. In Chicago alone there are at present in service some 2,000 electric vehicles and all indications point to an increasing number of installations during the coming year. About twenty-five of the most prominent mercantile establishments in Chicago are using the electric power wagon in preference to any other type for city service.

This development is due to a number of things. The great improvements in the design and construction of the electric vehicle have been brought forcibly to the attention of the public by the vehicle manufacturer. The marked improvements in storage batteries have contributed immeasurably to the present high standing of the electric and the activities of storage battery manufacturers has had much to due with its development. However, during the past few years both the vehicle and battery manufacturers have succeeded in enlisting the co-operation of the central station in the work of introducing the electric vehicle, and wherever such co-operation has been given, the results have been exceedingly encouraging.

In Chicago, the Commonwealth Edison Company has always taken an active interest in the electric vehicle and the gratifying showing of today is perhaps due to its activities more than to any other one influence.

The work of the Chicago Company has been extremely hard, it being necessary to overcome the prejudices of Chicagoans against the electric vehicle, formed a number of years ago when a local transportation company placed in service a number of electric vehicles which, owing to a number of grievous mistakes in construction, made an exceedingly poor showing. The Commonwealth Edison Company at this early date realized the inherent advantages of the electric vehicle and demonstrated its faith by purchasing a number of these vehicles, remodeling them and placing them in the Company's service. About nine of these wagons are still in use. Since that time horses and wagons were supplanted, as rapidly as possible, with electric wagons, and today the Company has in operation over thirty electric vehicles.

A NUMBER OF COMMONWEALTH EDISON ELECTRIC VEHICLES.

As radical a change of policy as this was not determined without a careful study of the cost of operation, this study having been made possible by the keeping of complete statistics for several years on the cost of operating the Company's automobiles as well as its horses and horse vehicles. The results shown by these statistics proved conclusively that a marked saving was to be made by the employment of electric vehicles for city service.

Having thus demonstrated to itself, beyond any doubt, that the electric vehicle, in addition to its many inherent advantages, would prove a profitable investment for its customers, the Commonwealth Edison Company inaugurated an active campaign which is still in progress and which as already stated has resulted in the placing of 2,000 electrics in Chicago, and the establishing of some sixty-five public charging stations, all of which are using central-station current. In addition there are installed throughout the city a large number of private charging stations, the combined business proving a very profitable off-peak load.

The first step in the campaign was the issuance of a map of Chicago, showing the best automobile routes to various points of interest, the extensive boulevard system of Chicago and the relative location of the various public charging stations. These roads and stations were easily distinguishable, being printed in red ink, and the map could be folded and conveniently carried in the pocket. In addition to being of great service to owners of cars, these maps indicated to prospective purchasers the convenience of the charging stations about town.

The Company next distributed a "vest pocket" list of charging stations in and about Chicago, arranged according to geographical order. These folders were of attractive appearance, of good lasting stock, and also proved convenient to owners and prospective purchasers alike.

Perhaps the most valuable contribution in the campaign of the Commonwealth Edison Company is a handbook on the electric vehicle which the Company distributed to all interested. This book contains a list of important general rules and instructions governing the care and maintenance of the electric vehicle; a description of modern storage batteries; valuable information relative to the care of storage batteries;

descriptions of methods of keeping records of the performance of the battery; instruction as to reading meters and calculating bills for energy and other instructive data along these lines. In issuing these books the Company realized that much dissatisfaction with the electric vehicle was due to improper care and handling, and the results of thus informing users as to the proper operation and maintenance have been even greater than expected.

In one of the accompanying illustrations is shown the heading of a chart issued by the Commonwealth Edison Company which is the most recent step in its electric-vehicle campaign. By means of these charts an owner of an electric vehicle can keep an accurate record of the performance of his or her car for an entire month. By issuing such a chart the Company has succeeded in having many vehicle owners keep such a record, the result being that in the majority of cases the records are so satisfactory to the owners that the electric vehicle is boosted and advertised in one of the most result-producing ways.

Compliments of

COMMONWEALTH EDISON COMPANY

139 Adams Street, Telephone Randolph 1280 Chicago, Ill.

Electric Vehicle Battery Record of _____

Address _____

Make of Vehicle _____ No. of Cells _____

DATE	START		FINISH		START	FINISH	KILO-WATT HOURS	GRAVITY		AMP-HOUR METER		MILES RUN	REMARKS
	TIME	AMP'S	TIME	AMP'S	WATT METER READING	WATT METER READING		START	FINISH	DISCH.	CHARGE		
1													
2													
3													
4													
5													

HEADING OF RECORD CHART FOR ELECTRIC VEHICLES.

In addition to the foregoing the Commonwealth Edison Company publishes from time to time actual comparisons of the cost of using horse-drawn and electric vehicles which do a great deal towards influencing electric-vehicle business.

There are two men on the staff of the Company who devote their entire time to the electric-vehicle business. One is a battery expert who acts as consulting engineer for all electric vehicle users and instructs them in the proper care and use of the battery. The other keeps in touch with all vehicle owners and garages, lending assistance wherever needed and seeing that the customers of the Company are well taken care of.

National Campaign for Electric Vehicle Business.

One of the most complete and comprehensive plans for the further development and extended use of the electric vehicle has just been launched under highly auspicious conditions, and if it meets with the success which seems inevitable from a glance at the personnel of those interested, the result must be a very large and general increase in the number of electric vehicles used for pleasure and commercial purposes, from one end of this country to the other.

The movement is under the auspices of the Electric Vehicle Association of America, which has appointed a Publicity and Advertising Committee for the purpose indicated.

N. F. Brady, first vice-president of the New York Edison Company, is the chairman of this Committee, which includes in its membership the following men of the very highest standing and influence in the electric lighting industry: N. F. Brady, Samuel Insull, J. B. McCall, C. L. Edgar, W. W. Freeman, Charles R. Huntley, Alexander Dow, George H. Harries, Samuel Scovil, F. W. Frueauff, H. M. Byllesby, J. G. White, A. H. Ford, T. N. McCarter, Thomas Dolan, R. F. Pack, Arthur B. Lisle, Marcy L. Sperry, R. M. Searle, John B. Miller, John A. Britton, Alten S. Miller, G. W. Brine.

This committee held a meeting Saturday morning, December 3, in New York, at which it was decided to undertake a publicity campaign along broad national lines, and that in order to make such a campaign effective on the scale contemplated, it would be necessary to expend a minimum of $50,000 annually for at least three years. The general idea is to utilize the magazines and trade papers of national circulation. It was felt that very much more than the sum mentioned could be used to advantage, but that the amount specified was the least with which such a campaign could be inaugurated. Practically half this amount was subscribed by those present at this meeting.

A sub-committee was appointed to present the matter to all those interested, and solicit definite subscriptions. This committee consists of W. W. Freeman, Brooklyn, chairman; Frank W. Frueauff, Denver; Alten S. Miller, St. Louis; Arthur B. Lisle, Providence, and R. M. Searle, Rochester.

This sub-committee held a meeting immediately after the general committee adjourned, and decided to begin at once the solicitation of subscriptions from central stations on the basis of one-twenty-fifth of one per cent of the gross income of each company. It was felt that this would give all the electric lighting companies a definite basis of subscription in proportion to the benefits to be received from such a campaign.

The well founded expectation is that the total amount of subscriptions from central stations will be substantially duplicated by the manufacturers and others interested in the sale of apparatus.

Meeting of Byllesby Managers.

The second annual convention of the managers and department heads of H. M. Byllesby & Company and affiliated companies will be held at the Congress Hotel, Chicago, January 17-20 inclusive. This Company, which has headquarters at Chicago, operates and manages a considerable number of electric, gas and street railway properties in the west and south.

It is the belief of President Byllesby that the annual meeting and interchange of ideas among managers and department heads accomplishes much towards improving the service offered the public in the various cities in which it operates.

The Bohemian Academy of Sciences at Prague has received, by the will of Councillor Wiehl, the sum of $200,000 to be used for the encouragement of scientific and technical research.

Canvassing by Telephone.

A paper bearing this title, which was presented at the recent meeting of the Association of Edison Illuminating Companies by T. J. Jones, describes a method of increasing revenue from existing customers of an electric light and power company and of obtaining new customers through the creation of first interest by the use of the telephone.

A list of all prospective customers compiled from the telephone directory is made up and classified according to location and further divided into business and residence prospects. Regarding time of calling it is suggested that the evening between 8 and 9 is preferable, owing to the fact that the head of the house is generally in at that time and a sufficient length of time has elapsed after the evening meal. A special card on which the name and address of the prospect and the results of the call should be entered is recommended to the solicitor covering the territory in which the prospective customer is located.

Approaching a man or woman by telephone should be done as tactfully as soliciting in person. The author of the method states that in the city where this method is used the following conversation has been permanently adopted:

"This is Mr. ——, local representative of the —— Company. We are making a canvass of your street, have recently added Mr. —— to our lines, and desire to know whether you care to consider electric service similar to that of your neighbor."

The results reported indicate that this method has been highly successful and plans are being made to "cover" a much larger number of prospective customers by telephone.

Preparing for an Electrical Christmas.

The Toronto Electric Light Company, Toronto, Canada, is sending out an attractive little booklet containing many suggestions for Christmas gifts, termed "Turn the Switch Gifts."

The list includes practically every domestic appliance known. Many are illustrated, the views demonstrating the conveniences of such devices. This method of calling the attention of its customers to the suitability of electrical devices for Christmas gifts should be productive of good returns.

A Profitable Scheme.

A fine example of decorative advertising street lighting, due to individual enterprise, has just recently been installed in Brooklyn.

Hugo Tollner, who is building a block of stores and apartments on Bedford Avenue, between Putnam Avenue and Madison Street, decided at the solicitation of an Edison salesman that it would be good policy to install a distinctive and attractive system of street illumination as an advertisement for his property.

The details of the installation were worked out between the owner and the sales force of the Company. The result is shown in the illustration. The posts were made by the J. L. Mott Iron Works of New York.

The block is 200 feet long, and six

SPECIAL LIGHTING IN BROOKLYN.

standards are used. Each standard is equipped with five 100-watt tungsten lamps, with sixteen-inch opal globes.

The resulting illumination is superb, and the effect can possibly be best stated by its inverse, *i. e.*, the reverse side of the street is thrown so completely in the shade, that the merchants there have taken into immediate contemplation the installation of additional lighting, which will prevent the business all being done on the opposite side.

Since this lighting has been installed, although Mr. Tollner's buildings are not yet completed, there has been already a 300-per-cent increase in the number of inquiries concerning them, and Mr. Tollner is so well pleased and satisfied with the effectiveness of this advertising, that he has contracted to have two additional standards, one on each of the side streets, thus completely enclosing his property.

The standards are installed on the sidewalk abutting the curb. They are switched on and off by the Company in accordance with a definite schedule.

The Brooklyn Edison Company has advertised this installation extensively in the local newspapers, and already a number of merchants in other parts of the city have become interested in the project of special decorative street illuminations for their respective sections.

The Philadelphia Reliability Run for Electrics.

The Philadelphia Reliability Run of recent date, for electric pleasure cars was remarkable in many ways—first in the number of cars entered. Forty-one electrics of all the leading makes entered the contest, thirty-nine started, and thirty-six completed the run of fifty miles without delay or accident. Ten of these electrics were driven by ladies, hence it goes without saying that this was not a speed contest and that no dangerous feats were undertaken.

The course was laid from Broad and Chestnut Streets, through Germantown and Chestnut Hill to the Wissahickon Drive and back through Fairmount Park to Overbrook and the Merion Cricket Club where lunch was served. The home trip was on an equally hilly course and the whole run was made a splendid roadability test of the electric pleasure carriage. Twenty-six of the thirty-nine cars starting made perfect scores.

No prizes were awarded for speed or reliability but a sort of guessing contest was arranged in which each owner that entered a car was asked to give his guess as to the probable time necessary to make the trip. Two Studebakers, one Waverley and one Baker vehicle won the prizes.

Power Installations in Baltimore.

The November issue of *Electric Power*, a publication issued by the Consolidated Gas & Electric Company, of Baltimore, in the interests of central-station power, contains a number of descriptions of interesting installations recently made by the Company.

Among the industries represented in these installations is an iron foundry, a pattern shop, a wagon factory, a spice factory and a paper-box factory.

This method of informing the public of its work and its progress has been found very successful by the Company.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

STREET LIGHTING BY MODERN ELECTRIC LAMPS.

SOME INTERESTING COMMENTS BY AN ENGLISH ENGINEER.

At the meeting of the Institution of Electrical Engineers held at London on November 24, Haydn T. Harrison read an important paper on "Street Lighting by Modern Electric Lamps." This paper was an excellent review of the present situation and, while particularly based on the conditions prevailing in England, many of which are not duplicated in this country, the paper contained much of common interest to all electrical men who have to deal with street-lighting problems. An abstract of these portions of the paper is therefore given below.

In the very early days of electric lighting the streets which required increased illumination owing to their importance, were changed from gas to high-candlepower lamps, such as arc lamps; but, unfortunately for electrical engineers, these streets were comparatively few in number compared to the thousands of miles of less important streets and roads which were and are lighted by incandescent gas lamps. Moreover, the high-candlepower arc lamps which electrical engineers had at their disposal for competitive purposes gave their maximum candlepower at an angle requiring that they should be placed at a considerable height, and at a short distance apart when required to obtain an even illumination, which resulted in a high cost per mile of lighting. The improvements connected with electric lamps which have taken place within the last two years have placed electrical engineers in a very different position, not only as regards large units of light, arc lamps being now available which give their maximum candlepower in the direction most suitable for street lighting, but also with small units of lights, such as tungsten lamps, which give over three times the candlepower of the carbon lamps for the same consumption of energy. It was the advent of these efficient small units of light that gave electrical engineers an opportunity of competing favorably with gas for side-street lighting, as they can be installed without a heavy outlay in capital. And as most of the streets are sufficiently well illuminated by small units a very large and valuable load results.

In nearly every town and city of this country (England), gas, being the illuminant available at the time when the streets were built, was naturally chosen for the purpose, and electrical engineers have found that in order to displace it they must be in a position to supply lamps of about the same candlepower either at an equal or a lower cost, as it is often not considered advisable to go to the expense of scrapping existing posts and lanterns. I propose, therefore, to lay before you the figures relating to the borough of St. Marylebone, where the incandescent gas lamps have lately been replaced by tungsten lamps.

In this case an outside testing authority intimately connected with the gas industry was instructed to test at random 100 street gas lamps in the district. The results showed an average for the single four-and-one-half-cubic-foot gas mantles of 50 candlepower and 76.6 for the double mantles. It was decided that the single lamps should be replaced by two 115-volt 35-watt Osram lamps in series, and the double lamps by two 55-watt lamps.

The existing gas lamp-posts and lanterns being the property of the Council, and having been maintained in good condition, it was decided to retain them. The light from tungsten lamps having a profile curve favorable to street lighting it was only necessary to accentuate this by means of reflectors. The use of something which would counteract the effect of high intrinsic brilliancy of the light source on the iris of the eyes had proved in my experience a very important point. Therefore I submitted a reflector for this purpose which was duly approved. This reflector, which is in shape similar to an inverted wedge with suitably curved sides, attained both the above objects, increasing the candlepower of the rays near the horizontal to nearly double that of the lamps only and to six times the vertical rays. The chief features of the equipment are: a large surface of white reflector above the lamp filaments with no intervening lamp caps or holders, thus attaining the objects mentioned above; anti-vibration holders to protect the lamps from harm due to street vibration, or jars when switching on or off; suitable watertight switches and fuses and sealing chambers of sufficiently small dimensions to go between the bottom of the lantern and the top of the post; all of which were designed in such a way that they could be erected at slight cost. The cost of converting 1,964 lanterns and connecting them to existing distributors was $28,940, or an average of less than $15 per post. This work was carried through in three months at an average of nearly 200 posts a week without in any way interfering with the continuity of supply to a single customer. The excellent results obtained have led to the Council deciding to convert the remaining 1,385 lanterns in this district, but owing to these not being adjacent to existing distributors, new ducts and mains were necessary.

The 1,964 lamps when lighted by gas cost the Council for gas, lighting, extinguishing, cleaning and maintenance, $44,090 per annum. The gas contractors when asked for a revised tender reduced their price considerably, but were unable to compete with the tenders of the electricity department, which amounted to $36,750 per annum.

As a consumer, a street lamp is very attractive, the load-factor is good, no expensive meters or other apparatus are necessary, and it is not likely to have to be cut off owing to termination of tenancy or vagaries of that description. The street lamp acts as an advertisement to the electricity undertaking, and the local authority controls its own public lighting instead of being in the hands of its bitterest opponent. In the case of Marylebone, not only were all these advantages gained, but a large saving—namely, $7,340 a year—was made in the lighting rate, the electricity undertaking benefited, and the illumination of the streets was improved. The tests on the gas lamps mentioned previously are compared with tests on the electric lamps as shown above. As regards the illumination, this was, of course, increased directly in proportion to the increase of candlepower, as the position, height, etc., of the lamps remained the same. In the important thoroughfares there are an average of seventy-six posts to the mile, and in the less important streets sixty-five posts to the mile.

TESTS OF MARYLEBONE STREET LAMPS.

Original.	Candle-power.	Replaced by Osram Lamps.	Candle-power at 20°.	Candle-power at 10°.
Single gas mantle	45	Two 35-watt	55	100
Double gas mantle	76	Two 55-watt	78	130
Double gas mantle	76	Two 80-watt	135	220

Before leaving the subject of the Marylebone lighting, it is necessary to consider a third type of thoroughfare, namely, Oxford Street. With the exception of London and some of the more important towns, there are few places where it is necessary, or where the authorities could afford to illuminate any streets up to the degree attained in Oxford Street; nevertheless, it is interesting to ascertain the cost of illumination up to this standard where necessary, and also to what extent the present cost could be reduced by modern appliances. At the time Oxford Street was changed from gas to electric lamps the most efficient lamp available for the purpose was the converging carbon flame-arc lamp. This lamp was therefore used, the globes being of the opalescent type recommended by the makers at that time. Two such lamps were erected on center poles where favorable, which were at distances of nearly 200 feet; this resulted in a minimum horizontal illumination of 0.11 candle-foot; thus it will be seen that the cost of this type of lamp works out at nearly $100 per annum.

Since that time the arc-lamp makers have turned their attention to altering the distribution of light from flame lamps in order to make them more suitable for street lighting.

For instance, in the case of arc lighting it is difficult to arrange for the arc when erected on posts to be higher than twenty-five feet from the ground, and the distance between them is rarely less than 150 feet, and is sometimes as much as 300 feet, therefore the light rays which reach the point of minimum illumination are those which emanate at ten to seventeen degrees from the horizontal.

A considerable advance has been made in the right direction by the introduction of the dioptric globe; for example, if these dioptric globes are used the increased il-

lumination is sixty per cent without appreciably increasing the cost of maintenance. If a clear outer globe is used the illumination is more than doubled.

The current at which the lamps are run makes far from proportionate difference, low-current arc lamps being always much lower in candlepower output per watt than those taking more current, and this particularly applies to flame lamps. The vertical-carbon lamps, though of much higher efficiency, are not so steady burning as the inclined-carbon lamps on account of the movement of the arc. I have found in the street when photometering that this variation is sometimes fifty per cent. As regards globes, the absorption of these differs enormously, and the greatest care should be taken in their selection, the only method being by testing the lamps and globes under actual working conditions.

While discussing highly illuminated streets and the use of high-candlepower units of light, the relative results obtained by the use of high-pressure gas lamps is of interest. Therefore I will refer to the tests by J. T. Morris, from which he draws the conclusion that the candlepower of a high-pressure gas lamp varied fifty per cent, depending on the quality and pressure of the gas. His figures show that from thirty to thirty-four candlepower per cubic foot of gas consumed per hour is a very average result—this is when working at a pressure of four inches of mercury. As my own tests tend to corroborate this, I will take as an example a nominal 1,500-candlepower Keith lamp, which gave on test between 720 and 780 candlepower, with a consumption of twenty-three cubic feet per hour. This, when compared with a flame-arc lamp giving five candlepower per watt at two cents per kilowatt-hour, would have to be supplied with gas at fourteen cents per 1,000 cubic feet in order to produce the same light for an equal cost, and thus it is obvious that even high-pressure gas lamps do not compare favorably in cost with those high-candlepower electric arc lamps, which embody the improvements of the last few years.

At the beginning of this paper I referred to the early days of electric lighting, when the open-type arc lamp was the most efficient lamp available, and was therefore erected in considerable numbers for lighting the more important thoroughfares. This was the case in two districts bordering on Marylebone, in each of which nearly 1,000 of these lamps were erected, and are still in use. In one of these districts where they are supplied from the mains of an electric supply company they are spread over nearly twenty-five miles of streets, the cost per mile of lighting being about $4,400, and the minimum illumination resulting in this case being 0.05 candle-foot. On referring to the Marylebone figures, where the same class of street is illuminated by means of tungsten lamps, it will be found that a minimum illumination of 0.08 candle-foot, nearly half as much again, is obtained at a cost of $2,070 per mile, or less than half. In the other neighboring district the arc lamps are spread over nearly thirty-seven miles of streets, and are arranged to give two different degrees of minimum illumination, namely, in the important thoroughfares 0.012 candle-foot, and 0.008 candle-foot in the lesser thoroughfares; at the prices charged this works out at about $2,250 and $1,750 per mile respectively.

These examples are sufficient to show that, with the exception of very important streets, the tungsten lamp will give a better result at lower cost than the ordinary open type of arc lamps; but, of course, where the arc lamp has been used in the past, and the question of improving the illumination and of reducing the cost is under consideration, it would be unwise to incur fresh capital charges by replacing the existing arc lamps with a large number of small posts and fittings, and therefore I propose to call your attention to Croydon, where this problem has been most successfully dealt with. The borough electrical engineer, realizing that certain classes of road were not of sufficient importance to require that higher degree of illumination obtainable by the use of flame-arc lamps, decided to try the experiment of using groups of tungsten lamps contained in one lantern fixed as high as possible from the ground. The improvement in the evenness of the illumination was very noticeable and the new form of lighting was generally approved. It was found that a group of three 100-watt Osram lamps contained in a suitably designed and constructed lantern, when erected twenty to twenty-three feet above the ground, gave a much better minimum and much more even illumination than the arc lamps, with the result that nearly ten miles of road have already been converted to this system of lighting. These lanterns, which were the outcome of a considerable number of experiments and tests, carried out by the engineer and his assistants in conjunction with the writer, are designed to embody the same principles as the Marylebone fitting, namely, to have a larger area of white reflecting surface in very close proximity to the incandescent metal of the lamp, with the object of making the source of light appear large so as not to strain the eye in any way. And owing to the height at which these lamps are erected this white surface can be, and is designed to act as an efficient reflector, and does considerably improve the distribution of light by nearly doubling the candlepower at ten to twenty degrees from the horizontal. The cost per mile works out at approximately $1,000 per annum, thus a minimum illumination double that of arc lamps is obtained, and at slightly over half the cost. It is interesting to note that when these roads were lighted by gas mantles the minimum direct illumination was 0.0036 candle-foot, and thus the illumination is now about seven times as high, the cost being about three times greater.

As in many towns the open-type arc lamps have been installed on a series system, it would necessitate considerable expenditure of capital to replace them by the more efficient grouped tungsten lamps if the mains had to be disturbed in order to put in a parallel system of cables, moreover individual switching then becomes necessary, which slightly increases the cost. In order to overcome these difficulties the author has devised a combined lantern and cut-out which permits the arc lamp being replaced by a group of tungsten lamps, of which one is a spare lamp placed in a conspicuous position in the globe, and comes into operation in the event of any of the other lamps failing. The usual construction of these lanterns is as follows: The lamps nominally in circuit are placed round in a circle and are each connected in parallel through the winding of an electromagnet to the series mains. The spare lamp is placed in the center of the group at a lower level, and is connected through a contact operated by the electromagnet to the series mains. The electromagnet is so wound that when the normal lamps are lighted, and the current is passing through the coils in series with them, the magnet is not excited, but, in the event of a lamp failing, the balance of the ampere-turns is upset, and thus the magnet excited attracts its armature and connects the spare lamp. The advantage of this arrangement is that the automatic cut-in only operates in case of failure of a lamp, thus the contact is rarely made, and the circuit is never broken at the points of contact.

Among other examples of the great improvement possible with modern electric lamps, I would like to mention Harrogate, where the engineer, Mr. Wilkinson, has replaced the arc lamps by four 100-candlepower tungsten lamps, arranged on spreading arms at a considerable height, the result being excellent both as regards illumination and appearance. It is interesting to note that at Harrogate the lamps are used without globes, but are provided with prismatic reflectors, which leads up to the question of reflectors generally. It is important that the reflectors should be designed with the object of reducing the effect of glare, in other words, counteracting the high intrinsic brilliancy of the light source. There are many ways of reducing the deleterious effect of high intrinsic brilliancy of light sources, without interfering with the effiency of the light. A very ingenious method has lately been invented by Mr. Pragnall, based on the principle that nearly all light sources cover an appreciable area, thus by fixing thin sheets of metal having white surfaces, adjacent and radially to the light source, it is seen in the midst of an illuminated white surface, and not against the dark sky or distant surroundings, while at the same time practically no light is lost owing to the surfaces being thin and radial to the lamp.

The accompanying table gives the total candlepower necessary to produce a minimum of illumination (horizontal) of 0.1 candle-foot with lamps spaced at different distances aad also at two different heights. From this table two important features are very noticeable, namely, the large reduction in total candlepower necessary to produce the same minimum degree of illumination with small units of light placed close together, and the effect of height of the lamps on horizontal illumination. It will be noticed that when the lamps are spaced at thirty yards only one-ninth of the total candlepower is necessary to give the same result as when they are placed 100 yards apart, therefore from the table of costs per candlepower it will be seen that unless a lamp giving a very high candlepower at low cost be used, the closer spacing would be the cheaper alternative. Again, converging flame lamps (unless provided with dioptric globes) when erected at seventy yards, give illumination at the same cost, equal to small units of light placed between forty and fifty yards apart, provided, of course, the small units of light are fixed at the same height.

CANDLEPOWER NECESSARY FOR MINIMUM ILLUMINATION OF 0.1 CANDLE-FOOT.

Space between Lamps. Yards.	Candlepower of Lamps. 12 ft. high.	20 ft. high.	Total Candlepower per Mile. 12 ft. high.	20 ft. high.
100	....	8,800	.....	156,000
90	....	6,300	.....	125,000
80	7,300	4,539	160,000	100,000
70	4,800	3,060	121,000	76,600
60	3,140	1,950	92,000	57,000
50	1,820	1,186	63,500	41,600
40	950	620	41,500	27,300
30	400	300	23,300	17,600

With reference to the height of lamps, obviously in order to obtain even illumination they should be placed as high as possible. For instance, in Baker Street, if the lamps had been twenty feet high the minimum horizontal illumination on the ground would have been 0.11 candle-foot instead of 0.08, or an increase of nearly fifty per cent, but I doubt whether the lighting committee or the public would agree that the illumination of the street had been improved fifty per cent, and am certain that there would be no hesitation in their choice between increasing the height of the lamps eight feet or increasing the candlepower fifty per cent, provided the increased candlepower cost no more. This, to my mind, demonstrates clearly one of the objections to horizontal illumination as the gauge of street lighting, for the increase in the height of the lamps would not in any way increase the illumination of pedestrians and vehicles

or other vertical objects, and it is certainly misleading owing to the introduction of the cosine factor. On the other hand, the specifying of minimum horizontal illumination does not encourage raising the height of the lamps, but, as I have mentioned in previous writings, the factor of direct illumination covers this point when the maximum and minimum are stated. That the difference between the maximum and minimum illumination at any point of a street should be as small as possible is so important that it is gratifying to note the comparatively low candlepower when measured near the vertical of the tungsten and modern arc lamps, especially when the former are in correctly designed lanterns. For example, maximum illumination with the inclined-carbon flame lamps is as high as ten candle-feet in Oxford Street, with a minimum of 0.11 candle-feet, or a diversity factor of ninety. In Baker Street the maximum illumination on the ground is 0.5 candle-feet, with a minimum of 0.08, a diversity factor of only six.

The above figures call attention to the considerable variation in the diversity factor of illumination. The importance of this factor cannot be over-rated. A. J. Sweet, in his paper read before the Franklin Institute, of Philadelphia, states that a ratio of maximum to minimum (illumination) of 4 to 1 is permissible, and points out that the present factor more frequently falls between 100 to 1, or even 500 to 1. For example, in Oxford Street, using flame-arc lamps, it is 99 to 1; whereas in Regent Street, where the same type of lamp was used, but with a dioptric globe, this was reduced to 13 to 1. In Victoria Street, the latest example of gas lighting, it is 20 to 1; whereas in the important streets of Marylebone it is 6 to 1. In both Regent Street and Marylebone this great advance was brought about by the correct use of globes and reflectors specially designed for the purpose. It is the possibility of using such globes and reflectors with electric lamps which gives them a great advantage over gas, where the dissipation of the great heat necessary for the efficient use of mantles makes the use of efficient globes and reflectors a practical impossibility.

For instance, in Victoria Street the light rays from the high-pressure gas lamps which reach the point of minimum illumination are only 1.5 times the power of those adjacent to the lamp post. In the case of the tungsten lamps in Marylebone, they are six times the power—hence the more even illumination. It is interesting to note that if the latter lamps had been placed a few feet higher, and spaced at, say, 100 posts to the mile, the illumination would have been even throughout the street with a diversity factor of unity. At first sight this would appear to considerably increase the cost, but this is not so, as the candlepower of the lamps could be reduced to one-fifth without reducing the illumination.

I must apologize if I have repeated too often examples and figures proving that the multiplicity of small-light units results in more efficient street lighting; but the fact that measurements and figures invariably lead to this conclusion proves that it is worthy of the consideration of those who have to deal with street-lighting problems.

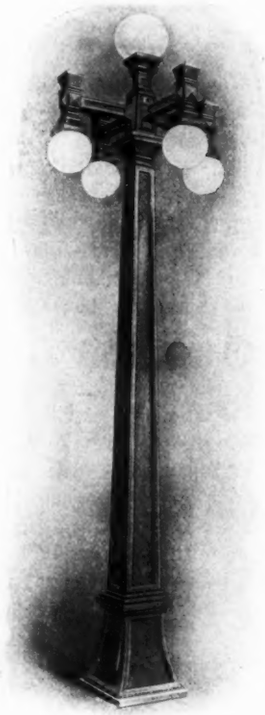
I am aware that the average man who is asked to compare brilliant and powerful lamps with the less brilliant but increased number of light sources will generally vote in favor of the powerful light, regardless of the result; but the fact that the Marylebone lighting has given satisfaction to all concerned does prove that in the long run even illumination is appreciated.

The eyesight of the present generation is suffering from the indiscriminate use of large glaring light units, unsuitably placed. Therefore it is important that those who are called upon to illuminate streets, where the minimum illumination cannot exceed 0.1 of a candle-foot, should not be tempted to accentuate this low figure by producing a few patches of bright light.

It is noticeable that in the past the small-light units derived from gas have been more economical for outdoor lighting than those produced by electricity. The reverse is now the case, therefore electrical engineers should be able to compete favorably, considering that the light they are able to supply is constant, reliable, capable of correct distribution, and easily manipulated, which must result in its adoption for exterior lighting in the same way as it has been so generally adopted for interior lighting.

Street Lighting in Elmira.

The city of Elmira, N. Y., has decided upon a new lighting installation for its main streets, and the new lamps and posts are to be ready before the holiday season. Tungsten-filament lamps are to be used, mounted upon ornamental posts. The design of post selected is shown in the accompany illustration.



STREET STANDARD FOR ELMIRA.

Luminous Arc Lamps in St. Louis.

As was narrated in these columns about a year ago, the downtown district of St. Louis, Mo., is almost entirely lighted by luminous, or magnetite, arc lamps mounted on ornamental standards. Further extensions of this system have been made during the present year, so that now there are over 2,500 of these lamps in use along St. Louis streets.

Mazda Lighting at Rochester.

Along Sibley Place, near East Avenue, in the residence district of Rochester, N. Y., twelve forty-watt Mazda lamps have been mounted on concrete columns. The trees and shrubbery are quite dense in that neighborhood and it has been found that the new tungsten lamps give a much brighter light and one freer from shadows than the former lights. The local central-station company is advocating the extension of this lighting system throughout the residence section.

Ornamental Tungsten Lighting in Worcester.

The Worcester Merchants' Association, of Worcester, Mass., has prepared a petition to the City Council for the ornamental lighting of the business streets of the city. The cost of the proposed installation, which is to comprise about 200 columns carrying five tungsten lamps each, is estimated at $16,830.

The territory proposed for the system is Main Street from Lincoln Square to Chandler Street, all of Front Street, Lincoln, Franklin and Washington Squares, around the Postoffice and City Hall Common.

Washington May Have Hydroelectric Power for Street Lighting.

The Commissioners of Washington, D. C., are planning to ask Congress for an appropriation of money for the preliminary steps towards harnessing the waterpower at Great Falls, on the Potomac River, so that the streets of the District of Columbia could be lighted by a lighting plant the property of the taxpayers.

A report submitted to the Commissioners states that electrical power can easily be transmitted from Great Falls to Washington; that there can be constructed at reasonable cost a power canal around the falls and a power plant below them; that there are available at the lowest stages of the river 6,395 horsepower without storage of water above the falls in the Seneca reach of the river and 8,648 horsepower with such storage, while only 4,458 horsepower is required for the present lighting purposes, and therefore it is entirely feasible to use the waterpower of the Potomac at Great Falls for the purpose of lighting the public buildings, grounds and streets of the District of Columbia.

TELEPHONY—TELEGRAPHY, and WIRELESS.

THE VALUE OF A PARTY-LINE LOCK-OUT SYSTEM IN REDUCING DEPRECIATION OF TELEPHONE EXCHANGES.

BY W. J. MISKELLA.

Analogous to the present discussions that are being waged by those connected with the financial side of public-service corporations and others, on methods of caring for and handling depreciation, it seems that descriptions of new devices and of systems that will reduce first costs or the amount of equipment to be maintained, and consequently depreciation values, are timely.

There is much to be said on depreciation, particularly of electrical apparatus, due to decrepitude and obsolescence because of the radical and numerous improvements that are being made day by day in this ripe age of amazing electrical invention. It has been assumed, and, no doubt correctly, that the bulk of these inventions refer to improvements on old inventions and ideas, which in a great many cases create success out of an arrangement which would otherwise be a rank failure.

The argument in favor of establishing some sort of a fund or means of providing money for the purchase and replacement of apparatus and equipment that will eventually become worn out and unfit for service is well taken and it is unquestionably true that many small corporations are unknowingly making themselves believe that their earnings are a certain definite amount; while, as a matter of fact, they would not dare to pay a yearly dividend so large as they have been paying were they brought to realize that they will at some future time be called upon to actually replace a given equipment; the failure to provide the money for which is almost sure to lead to disaster.

It must be understood that the matter is one entirely separate from so-called maintenance expenses, for the reason that a certain equipment may be maintained up to a certain limit, yet finally will have to be thrown away on account of decrepitude and on account of being past the scope of the maintenance department.

The reader may wonder what this preamble has to do with a discussion of new devices for a telephone exchange; but if a sweeping reduction of maintenance charges can be made, it is evident that the advocated depreciation funds, which are so closely related to maintenance funds, will be less in their total amount on a particular plant if the amount of equipment to be maintained in this plant be radically reduced.

No better example can be cited of an arrangement whereby maintenance costs in a telephone exchange can be radically reduced than the recent perfection of a party-line lock-out system. There have been improvements in mechanical apparatus which tend to increase the output of plants and reduce the complication of devices; but, to the knowledge of the writer no more important advance has been made, since the inauguration of trunking systems, in the interest of decreasing the present and required amount of dead, inanimate line and pole equipment, than the perfection of the successful party-line lock-out system.

First came the single central office with all the lines in a city emanating therefrom, but the complications that occurred in the extension of this system led to the establishment of local exchanges and the development of trunking systems, connecting the local offices in each city, which we will have to concede saved the companies miles upon miles of line material, and consequently many dollars in maintenance costs; and, in short, permitted the telephone system to develop into one of the greatest institutions for communication in the country.

The trunking system, however, did not affect the material and equipment of the lines emanating from the local exchanges or the exchanges in cities not large enough to require trunking systems, and it was not until the urgent demands for the wide extension of rural or farmers' lines that the inventive telephone geniuses were driven to perfect a party-line lock-out system which would not turn out to be a makeshift or an extra load on the maintenance department of the company that was unfortunate enough to be burdened with such a system in one of the original forms.

Without the party line, rural territory, as an important factor and branch of the telephone business, would be almost out of the question, and without the successful party-line lock-out system the extension of farmers' lines would be very limited. This means that in order to connect additional parties, additional line equipment would have to be provided, calling for a large investment of capital. With a party-line lock-out system increased dividends are made possible, not alone because of the shorter time required for making connections; not alone by the saving that is inaugurated in the maintenance department, but due to the fact that this system makes it possible to reduce the cost of rental to the subscriber and thereby enables the company to successfully solicit those customers who would otherwise fail to subscribe.

A successful party-line lock-out system means that the subscribers thereon are accorded absolutely individual service, just the same as on a private line, so far as talking is concerned, the only difference being that they are compelled to wait occasionally for a few minutes to get the line, but this inconvenience is reduced to a minimum by the display of a red signal at each of the other stations on the line while the one is using the line. Therefore, the party is not inconvenienced to the extent of having to try the line with his

receiver every few minutes until he finally gets his call through. This is a very clever innovation upon which the makers of lock-out systems are to be congratulated. The writer is aware that some years ago there were defects in this display-signal arrangement which would permit, and often cause, a false signal to be displayed, but he is certain that any cause for anxiety on this point has now been absolutely removed in the latest products. The person who is inclined to fear that he may be locked out at some time, in case of emergency, may be assured that the inventors have not overlooked this important fact and have provided for his convenience an arrangement whereby he may signal the central operator over the ringing circuit. Upon the receipt of such a signal the operator will immediately come in and interrupt the conversation that is in progress and obtain from the speakers permission for the third party to use the line, temporarily.

The inventors have also not overlooked the fact that this signal may be used maliciously and that there may be times when one of the subscribers on a party line would do anything in his power to interrupt or interfere with the conversation of his neighbor, for whom he may have a dislike, so they have arranged the circuit in such a way that any or all of the locked-out subscribers could even go so far as to tear out their individual telephones and work the emergency signal to their heart's content, but it would not be possible for them to interrupt the conversation that is being carried on. In fact, nothing short of cutting the main line would interfere with the conversation then in progress.

The statement has been made that the cost of service to the subscriber is reduced by the use of a party-line lock-out system and this statement may require a little explanation.

We will suppose that a telephone company located in a small city is now charging $1.00 per month for four-party service and $2.00 per month for private service. A reasonable charge for lock-out service would be $1.50. It would appeal to the $1.00 party-line man, for he would readily agree that fifty cents more per month for private service would be well worth the money. On the other hand, the man on the private line would recognize that the value of the lock-out service would be on a par with private service and would be willing to come in on that, instead of keeping his private line. Such a change might be desirable, as in the case of regrouping lines in outlying districts, as will be described below. Certainly the telephone company would be able to increase its number of subscribers due to the fact that private-line service could be obtained at a lower figure.

We will suppose that a magneto exchange receives several orders for private-line telephones, in an outlying district of their territory, where the feeders are not laid to supply the service called for. Obviously the telephone company will not look favorably upon the proposition of laying new feeders for these subscribers and would under ordinary circumstances file the application and attempt to care for it at some future day, thereby losing the benefit of an immediate cash remuneration, and in a great many cases failing to ever fill the orders.

Think of the boom that party-line lock-out system would be in such a case. Instead of turning down the orders for telephones in this remote district, the telephone company would immediately get hold of some of the subscribers in the supposed locality and get them to agree to accept a party-line lock-out telephone, which maybe in some case would have only two subscribers on it. Naturally the subscribers would be willing to agree and the telephone company would use their line for a feeder and run a pair of wires over to the new subscriber's house and the company would thereby increase its income immediately. But this is not all. If there should be a still further demand for new telephones in this supposed district, the telephone company could use this single pair of feeders to supply the demand up to as many as twenty telephones.

The working of these systems in their latest forms is especially pleasing. The rings are just as clear and pronounced on the far end of the line as they are on the near end. The cumbersome code-ringing system may be thrown out, because the lock-out system provides perfect individual ringing. The operator has the power to ring two or a number of subscribers simultaneously and this feature becomes quite valuable at times. For example, in the delivery of weather reports to farmers.

It is also interesting to note that these devices are now manufactured in compact form, so that it is not necessary to purchase complete lock-out telephones. The substation device is small and may be attached to any bridging telephone of standard make. The controlling and calling device is even more compact than the substation device and may be connected to any cord circuit in series with the cord, this connection, of course, being done on the cord-shelf.

As stated above, the demand for farmers' lines caused this system to be perfected to a fine degree and the farmers' are the ones who are going to gain the most benefits.

The same kind of energy and application that has made possible the adaptability of this feature to magneto lines bids fair to soon do just as much for the central-battery installation. In fact, the writer is informed by one of the manufacturers that the lock-out system applicable to central-battery equipments has already been successfully demonstrated and satisfactorily meets a rigid test in service.

Wireless Society of Massachusetts Institute.

The aims and scope of the Wireless Society of Massachusetts Institute of Technology, which held its first meeting of the school year recently at Boston, were the subjects of a recent account appearing in *The Tech*, the official paper of that school.

This society, which has for its object the study of wireless apparatus, as well as the practical operation of it, admits any student to membership, the only requirement being that he shall be interested in the subject. All members are to be given practice in both sending and receiving and it is expected that some will engage in experimental work.

In addition to the set of standard receiving instruments, and the antennae, which are said to be the best in the vicinity of Boston (with the exception of those at the Navy Yard), the society also has considerable other apparatus. Two miniature stations are to be installed and members stationed there for practice in sending and receiving. With the practice obtained in this way, and with the experience gained from the construction of apparatus, it is believed that the work of the society will be very profitable to its members.

Is a Rational Basis Possible for Telephone Rates?

In a paper with this title read at the meeting of the National Municipal League at Buffalo, N. Y., November 15, Prof. D. C. Jackson gave an affirmative answer and showed upon what basis the problem should be attacked. A company selling service has, for psychological reasons, a more complex problem than one selling a commodity, such as gas. Since telephone companies must supply a wide range of service, customers must be grouped according to their requirements, and each group must bring in revenue necessary to operate its service. The subscribers must be associated into such groups that in each group a large proportion of the subscribers are self-sustaining. These two requisites are commonly neglected. Reference was made to the investigations carried on in New York, Chicago, New Orleans and Baltimore, and the studies of commissions in Los Angeles, Massachusetts and Wisconsin.

The ideal method of charging is for each customer to pay in proportion to the service he receives, measured in quantity and quality. The revenues should cover all legitimate expenses, including return on the investment, and rates should raise only enough revenue for this purpose. To put the rates on a rational basis, there must be better reasons than the mere judgment of officials, for the differences between the charges for different classes of service. These differences now rest mostly on expendiency and what the traffic will bear. To improve on this, it is necessary to have statistical information of the traffic of each class of subscribers, the investment necessary to supply it, the expenses for operation and maintenance due to this traffic, etc. Interest, depreciation and maintenance should not be apportioned among the classes of service in direct ratio to the number of subscribers in each class, but with consideration also to the character of plant required and the amount of traffic. Two elements enter into the annual cost for a subscriber entailed by investment, readiness to serve and amount of service required, since the latter affects the design of plant. Other items entering the annual cost are operation, depreciation and general expenses, the latter including taxes, repairs, superintendence, advertising and general administration.

The reasonableness of rates is determined by the effectiveness and simplicity with which the schedule classifies the customers and the certainty with which the rates secure from each class the operating cost of its service, and a return on the investment. It is a question of public policy whether a company should be privileged to take a greater return on the investment from one class than from another.

Telephone Apparatus for Notre Dame.

The Western Electric Company recently donated to the Electrical Engineering School of Notre Dame University, for laboratory use, several complete sets of intercommunicating telephone apparatus. One type of central-energy outfit has been installed for some time in the telephone laboratory, but this form of intercommunicating device is entirely new and includes the latest improvements. The intercommunicating telephones were assembled at the factory and have already been installed in Science Hall, where they are available, not only for student purposes, but afford also telephonic communication between different parts of the building.

The same company has also contributed a number of subscribers' sets of the ordinary central-energy type, also all the parts of the switchboard, each part being mounted on a separate base provided with binding-posts, so that when they are assembled in the same order as in a commercial switchboard an incoming call may be traced through all the parts required for indicating it, and the connections for one subscriber to another may be studied in detail.

Damages for Lost Telegram.

In a decision of United States Supreme Court handed down on November 28, a telegraph company is held liable for damages incurred through the loss of a telegram. Because the Western Union Telegraph Company failed to transmit a message from Detroit, Mich., to Kansas City, Mo., after accepting it, the Company was held liable for more than $300 damages. The Company received forty cents to send the message.

The Commercial Milling Company, of Detroit, gave the message there to be delivered to a grain elevator company in Kansas City. The message got as far as Chicago, where it was lost. As a result the Detroit company claimed it had been damaged $2,000 by the failure to make a purchase of wheat.

The message was written on a telegraph blank, which contained an agreement that in case of non-delivery the telegraph company would be liable only for the amount received for sending the message. The trial court awarded a judgment of several hundred dollars in favor of the milling company, holding that the contract was invalid because it was in conflict with a state law. The Supreme Court sustained this finding.

Charlotte Electrical Properties Sold.

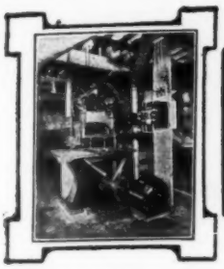
The signing of preliminary papers, November 26, for the formal transfer of the large holdings of the Charlotte Electric Street Railway Company and the Charlotte Gas and Electric Company to the Southern Power Company interests, and the sub-corporation, the Charlotte Power Company, marks the passing into new hands of one of the most extensive electrical properties in the entire South.

The price involved is strictly withheld by the promoters, but it is variously estimated at from $1,000,000 to $2,000,000. The two properties sold, commonly known as the 4 C's Company, include about twenty-five miles of street railway system, much of which is double-tracked, a large gas plant and also many hundred lighting and power contracts, all of which will pass into the hands of the Southern Power Company and Charlotte Power Company on January 1, 1911.

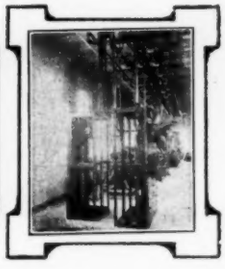
The new merger will give to the Southern Power Company not only the Charlotte Company's numerous hydro-electric developments in the South, but the street-railway and light and power systems in Charlotte, Anderson, S. C., and Greenville, S. C., the two last named having been bought in during the past fifteen months. L.

Wireless Equipment Compulsory.

A cable dispatch from Vienna dated November 28 states that the Austrian Government has ordered all Austrian merchant vessels carrying passengers from Austrian ports to places beyond the Mediterranean Sea to be equipped with wireless apparatus having a minimum range of 100 miles and capable of communication with ships and coast stations.



Industrial Power



Electric Motors in the Clothing Industry.

The application of electric motors has become so general that it is not now surprising to find them anywhere. Unfortunately, their application to the manufacture of clothing was held back, and up to a few years ago electric motors were little used in that industry.

There have been many reasons advanced for this, some contending that the manufacturers of electric motors were too busy supplying the demand of the large mechanical manufacturing plants, others that the clothing manufacturers had thought them expensive. In any case, the fact remains that only in recent years have electric motors been used to any extent.

In factories the electrical distribution of power has almost entirely displaced the long line shaft and enormous belts, and today machines and tools each have their individual motors. The reasons for this general use are many and varied. Perhaps the most important are flexibility, convenience and economy. The ability to place machines just where they are needed, regardless of the location of the power plant; the elimination of overhead obstructions, such as belts, shafting and pulleys; greater cleanliness; better conditions for employees through the reduction of dust and improvement in illumination; greater reliability; ability to control the speed of individual motors; ability to operate part of a plant economically without having to run idle shafting in other parts and reduced noise are some of the advantages of motor drives.

All of these will apply to the clothing industry, particularly that affecting the employees, for it is a well known fact that clothing shops are of necessity crowded and everything which will aid in giving workmen more air, light and comfort will soon pay for itself in increased production alone.

The photographs shown here illustrate the two principal forms of electric motor drives, one a group drive, the other an individual motor drive. Each has its advantages, and both are extensively used.

FIG. 1.—MOTOR DRIVING SEWING MACHINES.

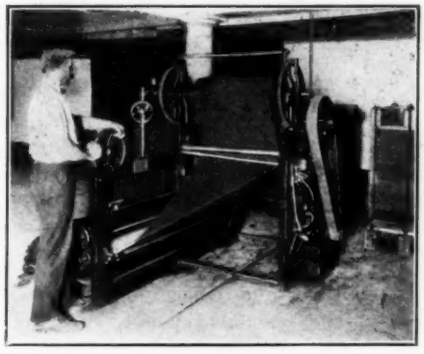


FIG. 2.—MOTOR DRIVING CLOTH-FOLDING MACHINE.

For driving sewing machines perhaps the most economical method of operation is to run a dozen or more machines from a shaft under the working table. Each individual machine, however, is under the control of the operator.

In Fig. 1 a two-horsepower motor is shown driving twelve machines. This motor also drives a blower for six gas irons and could, if necessary, easily drive a half-dozen or more machines. To start the machine the operator presses his foot on the treadle; to stop it he releases the pressure, and the machine stops instantly.

In some shops each sewing machine is individually driven, but while this has the advantage of the motor running only when the machine is in operation, the increase in the investment in most cases more than makes up for the saving in power, and this form of installation is not, therefore, economical.

In the cloth shrinking department of Marks Arnheim, custom tailors of New York city, one finds an excellent example of individual electric motor drives. The motor equipment of this establishment, which is one of the few custom tailoring houses in New York that shrinks its own cloth, consists of two small motors.

In Fig. 2 is shown an illustration of a one-horsepower electric motor connected to a cloth-folding machine. The other motor is a three-horsepower of the same type and is used to run a hydraulic press, one edge of which can be seen in the cut.

The cloth is first shrunk, then placed in the hydraulic press, when all the water is squeezed from it; afterwards it is thoroughly dried. When dry it is run through the folding machine and it is then ready for cutting.

The motors are connected to both the folding machine and the hydraulic press by belts, and each motor and machine makes a complete unit in itself. In this way each machine can be started and stopped at will, and power is used only when the machine is actually doing work.

Motors Prove Very Suitable in Vocational School.

The accompanying pictures were taken in a woodworking shop that is a model of its kind. The shop is part of the Vocational School for Boys, New York city. The various machines are driven by individual electric motors, a method that absolutely safeguards the boys against the mishaps that occur so frequently in shops where long belts and line shafts are present.

The illustrations show how well electric motors lend themselves to a layout of machinery that precludes accidents. Of course, besides the safety afforded, the motors are very economical in their operation, and greatly add to the convenience of the students. Furthermore, if any of the boys are particularly ambitious and desire to work outside of the scheduled hours they can very easily utilize any one of the machines without requesting that the whole equipment be put into operation.

MOTORS DRIVING WOODWORKING MACHINES.

MOTOR DRIVING SAW.

The Vocation School for Boys is intended for boys who desire an education that will prepare them for industrial work as distinguished from office work. Pupils are afforded an opportunity to learn the elements of a trade, and to study architectural, freehand and mechanical drawing, while continuing their general education along lines that will best fit in with this work. Everything necessary for the work is supplied by the school; there are no charges of any kind. The course is designed to cover one year or two years of work.

The boys who know definitely just what trade they want to follow, are permitted to start at that work, and devote most of their time to it. Those boys who have not decided on any special work are permitted and required to take several lines of trade work. The instructors then advise the boys intelligently and guide them to a wise choice. After this has been done, the pupils devote their time to the trade selected. All the instruction is individual, although the boys work in groups. There are no regular "classes," as the term is ordinarily used. Each boy is a unit, and he progresses as rapidly as his ability will permit.

The following vocational courses are offered: Wood work, metal work, printing, bookbinding. The divisions of woodworking covered are: House carpentry and construction, cabinet making and bench work, wood turning, pattern making in wood, and the use of wood-milling machinery.

The woodworking machinery includes two rip and cut-off saws, a universal saw, a four-roll single cylinder cabinet surfacer, a hand planer and jointer, a jig saw, and a knife grinder. Most of this was made by the Oliver Machinery Company, Grand Rapids, Mich.

The motors are of the induction type and operate at 1,700 revolutions per minute on 220-volt, two phase, sixty-cycle central-station energy. The motors are of Westinghouse manufacture.

Electric Pumps for Eiffel Tower.

The steam-driven pumping plant of the Eiffel Tower in Paris, France, is now for sale, as a contract for a new equipment of electrically driven pumps has already been closed. Curiously enough the same firm which supplied the original steam pumps will also install the electric pumps.

Mine Locomotives and Hoisting.

At the last meeting of the Pittsburg Section of the American Institute of Electrical Engineers papers were delivered on "Mine Locomotives," by G. M. Eaton and on "Hoisting" by W. Sykes. Many slides were shown illustrating the different types of locomotives and the varied service for which they are used. The use of driving rods for reducing the number of motors and increasing tractive effort, is coming into general use. Steel frames instead of cast iron, by the more open construction, make repairs more convenient as well as make possible lighter weight, when this is desirable. Gears are found to wear longer without gear cases than with them, due to the fact that when the cases are opened in the repair shop they cannot be reassembled tightly, and thus catch and hold the grit.

The greatest refinements in design of hoisting machinery are necessary only where power is comparatively expensive. A system has been designed similar to that used for rolling mills, that is, using a flywheel with a motor-generator set. In this case the control is by means of the generator field. Besides being much less wasteful of power than rheostatic control, it is possible to regulate the speed of the hoist much more accurately, particularly at low speeds as when inspecting the ropes, etc. In very deep mines, the weight of the rope becomes an important factor. This cannot be taken care of by a counterweight since the weight of the rope acts in the opposite direction at the top from what it does at the bottom. This is sometimes taken care of by the use of an endless rope, it thus being completely

counterbalanced at all times. Hoisting plants are often of large size, one being mentioned of 4,500-horsepower capacity. A plant of 2,000-horsepower was mentioned which uses rheostatic control of the motor.

Electricity in Marquette Range Mines.

Wherever such change will make for economy, electricity is to displace steam at the Marquette range mines of the Cleveland Cliffs Iron Company, the biggest operator in that Michigan district. Hoisting plants, air compressors, pumps, crushing plants and trams are all to be operated by electrical power. The transformation has already been in progress a number of months and it will be two or three years before the work is completed. Until such time as a big water power is developed—this in itself more than a million dollar project—the power will be furnished by two generating stations served by steam. One of these is at the Maas mine at Negaunee, and the other in the Swanzey field, twenty miles south of Negaunee. The capacity of each of these stations is 1,500 kilowatts. The power is conveyed to the various mines by transmission lines carried for miles on steel towers imbedded in concrete.

While the cost of installing the transmission stations and the various auxiliary plants and that of the other work, in connection with the project, will aggregate a very large sum, there eventually will be an important saving in fuel and labor. Many boilers will go out of commission and the present heavy coal bills will be cut to small figures. Electrical power is already being furnished to the Maas and Negaunee mines at Negaunee, the Cleveland Lake and Cliffs shaft at Ishpeming, the North Lake and Barnes west of there and the Austin, Princeton and Smith, in the Swanzey region, as well as to the principal shops of the company.—*The Mining World.*

Electric Power for Coal Mine.

The Independent Coal & Coke Company, Kenilworth, Utah, has started the erection of a waterpower plant on the Price River, which will supply current to the Company's Mines, four miles distant.

When the plant is in operation it is stated that the Company will establish a system of discharging blast shots by means of electricity.

New York Subway Problem.

A lack of agreement is conspicuous in the ideas which have been brought out in connection with proposals for the extensions of the subway system in New York City.

The city proposes to build and own the new subways and lease them to operating companies for use. Bids have been asked for construction according to plans prepared by the Public Service Commission, and a proposal has been made by W. G. McAdoo, of the Hudson & Manhattan Railroad Company, for the operation of an electric system. Under date of December 3 Mr. McAdoo has again written to the Commission stating that the offer will be withdrawn unless accepted by December 15.

In our COMMISSION NEWS last week, a letter from Frank J. Sprague to the Commission was abstracted, in which was discussed the features which should be embodied in any agreement made by the City for the operation of the subways. Speaking further on this subject recently, Mr. Sprague said:

"Mr. McAdoo and I do not agree on the ultimate cost of a system as laid out by the Public Service Commission and what I think would be an entirely satisfactory outlay. I object to the increase of more than thirty per cent in the size of the tunnels to accommodate the suburban trains of a foreign corporation, although I admit some increase is necessary above the present Interborough dimensions to provide for better track laying.

"I also am not in accord with the commission on the reservoir arrangement of their principal express stations for both express and local tracks, which not only increases the cost of these stations themselves, but adds a very material amount of trackage.

"I am in full accord with the general principle of city ownership of subways, a progressive construction with city funds on competitive bidding, under time forfeiture and premium contracts, with an operative lease to that responsible bidder who shall offer the maximum of return, such operator to be under the supervision of competent public authority."

Mr. Sprague figures out that instead of the triborough system costing, exclusive of equipment, $147,500,000, as stated recently by the chairman of the Public Service Commission, the total construction cost will be in the neighborhood of $203,600,000, all of which, he said, with the exception of about $3,600,000, must be from city funds. In addition, he said, the cost of equipment necessary for operation would amount to nearly $42,000,000 which, with the $3,600,000, must be supplied from private sources.

At request of Mayor Gaynor, A. Barton Hepburn, president of the Chamber of Commerce, and Henry R. Town, president of the Merchants' Association, have appointed a committee to investigate the subway problem.

On December 5 the Interborough Rapid Transit Company submitted to the Public Service Commission a proposal covering the construction and operation of more subway extensions in Manhattan, the Bronx and Brooklyn than any thus far received by the public authorities, and on terms much more liberal than any that the Interborough has before offered.

Coupled with this physical scope of the Interborough's offer, there is the general proposal of a five-cent fare over the entire system and its extensions. In addition the Company agrees to have the terms of both its present leases readjusted so that its lease on the entire system shall expire in forty-nine years from the beginning of operation on all the extensions.

As further strengthening the position of the city in respect to the unified system which the Interborough lays out, that company agrees to accept as to all the extensions to be built or operated the ten-year indeterminate feature which was inserted in the law at the last session of the legislature.

The third vital concession by the Interborough is the agreement to operate any future extensions of the Subway which the authorities may decide to build.

The city is to receive the entire net profits of the system for five years after it starts operation and divide net profits half and half thereafter. From the city the Interborough asks that $53,000,000 be put into the project, to which the Interborough proposes to add $75,000,000, exclusive of the $30,000,000 which it has already agreed to put up for the elevated third tracking in Manhattan and elevated extensions in the Bronx. The estimated cost of the subway extensions as laid out by the Interborough is $128,000,000 for construction and equipment.

The Interborough, on the operating side, asks that after paying operating expenses of all classes, net income shall be devoted first to the payment of interest on the bonds issued by the Company for its share of the construction, and for equipment, with a sinking fund of one per cent. After this is paid, income is proposed to be applied to payment of interest on the city bonds used in the construction.

BOOK REVIEWS.

"Edison: His Life and Inventions." By Frank Lewis Dyer and Thomas Commerford Martin. New York and London: Harper and Brothers. Cloth, two volumes, 989 pages (8x5 inches), illustrated. Supplied by Electrical Review Publishing Company, for $4.00

No story of the novelist can be more interesting and absorbing, more fascinating, than this story of the development of the inventions of the foremost inventor of all times. For a biography of Edison is necessarily a narrative of his work in perfecting the carbon-filament lamp, the dynamo, the phonograph, the carbon transmitter, quadruplex telegraphy, the stock ticker, the alkaline storage battery, the motion pictures, and the myriad of other marvels represented by 1,328 patent applications filed at Washington. And the reader who is not already familiar with his work will find in the complete list of his inventions many which are not popularly connected with his name. These include such things as paraffined paper and the typewriter, which he perfected for the inventor, Sholes.

The remarkable genius of Edison and his remarkable capacity for work and incapacity for sleep have often been dwelt upon, but it is only in reading the details of his career that one can come to a full appreciation of this Jules Verne of the workshop. His own lack of appreciation of the commercial value of his work is shown by the numerous instances in which he has been offered for inventions many times the figure which he has mentally set upon them.

The natural digressions from the main theme throw interesting sidelights upon many persons who have since become well known in electrical lines, including several connected in the early days with the Western Union Telegraph Company. The memories of Menlo Park also involve many workers who have made names for themselves.

Appendices contain descriptions of the more important of Edison's inventions and a complete list of the patents issued to him, the first of which in 1868, was for a vote recorder.

The authors are well qualified for their task, having been intimately associated with Edison, as well as widely informed upon the subjects which have received his greatest attention, and the narrative is written in pleasing style. The subject is quoted a great deal, and Edison read and approved the entire manuscript. In the front of the book is to be found over Edison's signature, "This book is published with my consent."

"Wireless Telegraph Construction for Amateurs." By Alfred P. Morgan. New York: D. Van Nostrand Company. Cloth, 188 pages (5x7¾ inches), illustrated. Supplied by the Electrical Review Publishing Company for $1.50.

In this work the author has endeavored to present a book embracing practical information for those who may wish to build for private or experimental use a set of wireless instruments which are applicable to use but which are not as expensive as the commercial apparatus. Every piece of apparatus that enters into a wireless telegraph system is considered, and by means of clear drawings and brief practical hints the reader is given sufficient instruction to construct efficient instruments. The style of treatment is as practical as is consistent with the subjects treated. The book also contains descriptions of all types of instruments now in general use. An interesting feature of the book is the last chapter, devoted to operation. This chapter deals with the codes in use, the arrangement of a wireless station, operating rules and electrical terms and definitions.

"Electric Trains." By H. M. Hobart. New York: D. Van Nostrand Company. Cloth, 201 pages (5x8¾ inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.50.

This book deals only with electric trains for city and suburban service and presents to the reader the most pertinent considerations governing the electrical aspects of the design and operation of electric trains. Among some of the subjects discussed may be mentioned the following: The Influence of the Number of Stops per Mile and of the Duration of Each Stop; The Influence of Momentum in a Service with Frequent Stops; A Method of Estimating the Energy Consumption of Trains on the Assumption of Negligible Train Friction and of 100 per cent Efficiency of the Electrical Equipment; The Efficiency of Electrical Equipment; Analysis of a Number of Energy Consumption Tests; Acceleration and Traction Force; Train Friction; The Heating of Railway Motors, etc. Each of these subjects is treated in as thorough a manner as is possible considering the scope of the book. The text is augmented by sixty-four tables, many of which are results of exhaustive and important tests on important phases of electric-railway work.

"Practical Hand Book for Millwrights." By Calvin F. Swingle, Chicago: Frederick J. Drake & Company. Cloth, 411 pages (5x 7½ inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.00.

This book contains a vast amount of information on phases of work encountered by millwrights in all stages of their work. Such subjects as the planning and arrangement of mill buildings; strength of materials; moment of inertia; shafting; journal bearings; couplings; transmission; gears; pulley locations, etc., are treated in a thorough and practical manner and all subjects directly connected with the installation of mill machinery are comprehensively discussed. Each subject forms a unit of the book and all are so indexed as to be very easily found.

"The Application of Arc Lamps to Practical Purposes." By Justus Eck. London: S. Rentell & Company, Ltd. Cloth, 191 pages (5½x8 inches), illustrated. Supplied by the Electrical Review Publishing Company for $0.60.

This book is intended as a help and guide to the large number of persons who have to deal with the arc lamp. The information given is, as far as possible, of a practical nature. The book is really a manual for arc-lamp users and covers such subjects as: Light radiation, efficiency of the various types of arc lamps, applications, connections, installation and maintenance. In the chapters on applications many typical and unique installations are described and the conditions governing each installation fully discussed. A noteworthy feature of the book is the tables which it includes. Among these may be mentioned illumination requirement of different industries, surface illumination from arc lamps, reflecting power of surfaces, candlepower at different angles, illuminating power of projections, etc. The concluding chapters of the book are devoted to detailed descriptions of the various type of arc lamps, including flaming arc lamp, on the market. The various accessories of arc lamps are also illustrated and described.

Exports of copper for the month of November were 29,097 tons, against 23,875 tons last year. Exports for the week ended December 1 were 7,594 tons.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

AURORA, ELGIN & CHICAGO.

The reports of the Aurora, Elgin & Chicago Railroad Company for the month of October, and four months ended October 31, compare as follows:

	1910	1909
October gross	$154,359	$137,663
October net	68,576	63,891
October surplus	34,797	34,477
Four months' gross	677,075	618,116
Four months' net	333,027	315,533
Four months' surplus	200,586	198,457

LONDON UNDERGROUND.

The associated companies of the Underground Electric Railways of London report for the month of October, 1910, compared as follows:

Metropolitan District Railway:	1910	1909
Gross receipts	£58,937	£54,718
Working expenses	28,219	28,619
Net receipts	30,718	26,099
London Electric Railway Company:		
Gross receipts	£61,358	£60,257
Working expenses	31,171	31,887
Net receipts	30,187	28,370
London United Tramways, Ltd.:		
Gross receipts	£28,149	£26,151
Working expenses	21,743	18,270
Net receipts	6,406	7,881

DETROIT UNITED RAILWAY.

The report of the Detroit United Railway Company for the month of October and ten months ended October 31, 1910, compares as follows:

	1910	1909
October gross	$ 809,455	$ 711,476
Expenses	523,058	471,500
October net	286,397	239,976
Other income	12,449	13,316
Total income	298,846	253,292
Charges and taxes	178,429	155,972
October surplus	120,417	97,320
Ten months' gross	7,837,434	6,674,908
Expenses	5,008,484	4,174,033
Ten months' net	2,828,950	2,500,875
Other income	125,657	121,522
Total income	2,954,607	2,622,397
Charges and taxes	1,689,549	1,565,480
Ten months' surplus	1,265,058	1,056,917

AMERICAN LIGHT AND TRACTION.

The American Light and Traction Company's surplus and earnings account for the twelve months ended September 30, 1910, compares as follows:

	1910	1909
Net earnings	$3,575,980	$3,089,190
Preferred dividends	854,172	854,172
Common dividends	926,701	740,353
Surplus	1,795,101	1,494,665
Previous surplus	5,622,683	5,184,027
Total surplus	7,417,784	6,678,692
Stk. div. com.	973,530	1,056,010
Profit and loss surplus Sept. 30	6,444,254	5,622,683

KEYSTONE TELEPHONE, OF PHILADELPHIA.

The report of the Keystone Telephone, of Philadelphia, for the month of October and four months ended October 31, compares as follows:

	1910	1909
October gross	$ 96,345	$ 91,560
Expenses	48,316	45,544
October net	48,029	46,016
Interest	24,519	24,981
October surplus	23,510	21,035
Four months' gross	379,154	364,411
Expenses	189,538	181,067
Four months' net	189,616	183,344
Interest	98,159	101,808
Four months' surplus	91,457	81,536

UTICA & MOHAWK VALLEY.

The report of the Utica & Mohawk Valley Railway Company for the quarter ended September 30, 1910, compares as follows:

	1910	1909
Total operating revenue	$354,160	$328,524
Total operating expense	180,508	194,855
Net operating revenue	173,652	133,669
Taxes accrued	17,080	18,423
Operating income	156,572	115,245
Non-operating income	747	1,010
Gross income	157,319	116,255
Total deductions from gross income	56,880	56,288
Net corporate income	100,439	59,967

ECONOMY LIGHT AND POWER.

The Economy Light & Power Company, of Joliet, Ill., reports for the year ended April 30, 1910, compared as follows:

	1910	1909
Gross	$406,746	$310,402
Operating expense	217,654	138,739
Net	189,092	171,663
Interest charges	75,743	65,324
Surplus	113,349	106,339

NEW YORK EDISON COMPANY.

The New York Public Service Commission has made public the following details of operation of the New York Edison Company for the year ended December 31, 1909 (the income account having previously been made public):

Public:	Kilowatt-hours delivered.	Total gross price.	Average price cents.
Municipal street lighting (arc)	15,053,919	$ 565,755	3.76
Municipal street lighting (incandescent)	280,420	25,755	9.18
Lighting municipal buildings	4,086,703	281,344	6.88
Municipal heat and power	309,841	18,590	6.00
Miscellaneous	1,722,409	127,835	7.42
Total	21,453,292	1,019,281	4.75
Commercial Metered Lighting:			
Retail	77,433,630	7,563,113	9.88
Intermediate wholesale	21,092,327	1,401,511	6.64
Special wholesale	52,125,181	2,258,362	4.33
Total	150,651,138	11,312,987	7.51
Breakdown service	1,244,563	119,209	9.58
Miscellaneous sales of current	303,411	16,005	5.28
Commercial Metered Power:			
Power	41,132,147	3,277,974	7.97
Storage battery	1,571,527	63,367	4.03
Miscellaneous high tension	5,236,699	98,613	1.88
Total	47,940,373	3,439,955	7.18
Railroad corporations	4,330,032	85,984	1.99
Other electrical corporations	38,425,664	552,436	1.41
Electrical jobbing		7,397	...
Total operating revenue	264,348,473	16,553,257	6.26

Total revenue deductions $9,810,555, operating income, $6,742,702, non-operating income (interest, dividends, rents, etc.), $1,001,474, gross income applicable to corporate and leased properties $7,774,176, fixed charges, etc., $3,024,368, net corporate income $4,719,807, dividends $2,703,060, balance $2,016,747, surplus adjustment (credit) $78,159, previous surplus $14,835,546, profit and loss surplus Dec. 31, 1909, $16,930,453.

Number of consumers December 31, 1909, were 84,995; number of meters in use 104,449, number of arc lamps 40,765, number of glow lamps 3,815,173.

CENTRAL UNION TELEPHONE.

The Central Union Telephone Company, the Bell company subsidiary operating in Indiana, Ohio, and southern Illinois, has issued its report for the year ended December 31, 1909. The income account compares as follows:

	1909.	1908.
Gross earnings	$4,999,424	$4,759,702
Operating expenses	3,636,062	3,709,531
Net earnings	1,363,362	1,050,171
Interest charges	1,363,272	1,199,415
Surplus	90	*149,244
Previous surplus	1,353,309	1,502,553
Total surplus	1,353,399	1,353,309

*Deficit.

BUFFALO GENERAL ELECTRIC.

The Buffalo General Electric Company has issued a report for the ten months ended October 31, 1910, compared as follows:

	1910.	1909.
Gross	$ 867,526	$ 772,298
Expenses and taxes	531,095	484,460
Net	336,431	287,839
Other income	33,107	30,759
Total income	369,538	318,598
Interest	111,511	102,302
Surplus	258,026	216,296

LAKE SHORE ELECTRIC.

The report of the Lake Shore Electric Railway Company for the month of October and ten months ended October 31, compares as follows:

	1910.	1909.
October gross	$ 105,075	$ 94,255
Expenses and taxes	55,940	49,754
October net	49,135	44,501
Charges	34,669	35,453
October surplus	14,465	9,047
Ten months' gross	1,018,739	929,316
Expenses and taxes	529,101	489,445
Ten months' net	489,638	439,871
Charges	347,678	344,546
Ten months' surplus	141,960	95,325

SCHENECTADY RAILWAY.

The report of the Schenectady Railway Company for the quarter ended September 30, 1910, compares as follows:

	1910	1909
Total operating revenue	$ 352,479	$ 296,164
Total operating expenses	189,265	160,018
Net operating revenue	163,214	136,146
Taxes accrued	13,679	12,788
Operating income	149,536	123,358
Non-operating income	2,847	3,400
Gross income	152,383	126,758
Total deductions from gross income	24,876	23,810
Net corporate income	127,507	102,948

WESTCHESTER ELECTRIC.

The report of the Westchester Electric Railroad Company for the quarter ended September 30, 1910, compares as follows:

	1910	1909
Total operating revenue	$ 172,753	$ 150,245
Total operating expenses	109,604	100,468
Net operating revenue	63,149	49,876
Taxes accrued	6,751	5,249
Operating income	56,398	44,627
Non-operating income	323	164
Gross income	56,721	44,791
Total deductions from gross income	9,606	9,721
Net corporate income	47,115	35,070

New Electrical and Mechanical Apparatus and Appliances.

Successful Operation of Storage-Battery Car.

The unusual spectacle of an electric car of street-railway pattern going at twenty-five miles an hour on a standard-gauge steam-railroad track was witnessed a few days ago on the line of the Erie Railroad, from West Orange to Forest Hills, N. J.

Thomas A. Edison was a member of the party watching the car, for the motive power was the storage battery invented by him, the first of its class to prove practical in its application to the railway-passenger traffic problem. With Mr. Edison were President Underwood of the Erie and a number of other representatives of large interests, all concerned in the trial.

One fact in connection with the test is notable,—that both the storage battery and the Klaxon warning signal, the latter replacing the usual compressed-air signal, came into existence through the automobile. The storage battery is a part of thousands of electric autos and the Klaxon warning signal is known to be reliable under all circumstances.

The car used is of new design, from wheels to roof. It is light, yet fully as strong as if it weighed ten times as much, as far as practical demands are concerned.

The unnecessary consumption of power on cars obtaining with the solid axle car, is eliminated. Naturally, when two wheels are joined together rigidly on the same axle, and the car is forced around a curve, the outside wheel travels a great deal further than the inside wheel. Therefore, the inside wheel must slip and grind against the inside rail with consequent enormous consumption of power and wear of wheel and rail. With this car each wheel is as independent as are the wheels of automobiles, turning independently on the same axle, and each wheel is driven by its own motor. These wheels are mounted on roller bearings, thereby eliminating bearing friction.

Silent chains are used to transmit the power from the motors to the wheels, with consequent quiet running and the absence of all gear noises so common with trolley cars. The batteries—180 in all, and of the A-8 type—are under the seats. A separate set of batteries supplies current for lights.

The car travels eighty-five miles per charge on the basis of stopping ten times per mile, letting off and taking on passengers. If allowed to run without stops, it would probably run 125 miles. The scheduled speed is eighteen miles per hour, but the car has reached a speed of thirty-five miles per hour on a long, straight, level track.

There are four motors, each of which is rated at five horsepower, or twenty horsepower in all. The car weighs about eleven tons, and accelerates one mile per hour per second; that is, at the end of the first second after starting, it is traveling at one mile per hour; at the end of the second, two miles per hour; at the end of the third, three miles per hour, etc., until fully accelerated.

It is said to consume one-fifth the electricity per car mile that the ordinary electric car consumes and can be operated on the spur lines of railroads at one-eighth the cost of operating a spur-line train consisting of locomotive and one or more cars.

The Klaxon warning signal is on the car roof at either end, and operated by the same batteries which run the motors.

A Telephone 12,000 Feet from Daylight.

The man at the telephone in the accompanying illustration is a Pennsylvania miner, standing in the engine room, 12,000 feet down a four-per-cent grade from the entrance to the shaft. To obtain a flashlight photograph under these conditions was a difficult task, but the picture makes very apparent the usefulness of an underground telephone system.

The instrument shown is one of the Western Electric Company's type, designed especially for this service.

USING AN UNDERGROUND TELEPHONE.

The inner parts of the telephone are protected by two iron doors, only one of which, as may be seen in the cut, is opened when the wire is being used. The set is well protected against moisture, gases and fumes, which would make the ordinary commercial telephone useless for work in mines.

Following the disasters in underground shafts of a year ago, the legislature of Illinois passed a law making compulsory the installation of adequate protective devices in mines. The result was that the telephone manufacturers hastened to place on the market instruments to withstand the severe tests of service in underground shafts. The reinforced metal covering of the set may well be called bomb-proof.

It is reported that in one of the coal mines of Pennsylvania not long ago these ironclad telephones were instrumental in locating and checking a blaze which might have proved disastrous. In another instance the telephone called a surgeon to the entrance of a shaft, to meet a car bearing an injured miner, and in this way a fatality was averted. Telephone and signal systems are expected to reduce greatly the possibility of another disaster like that of last year in the Cherry mine.

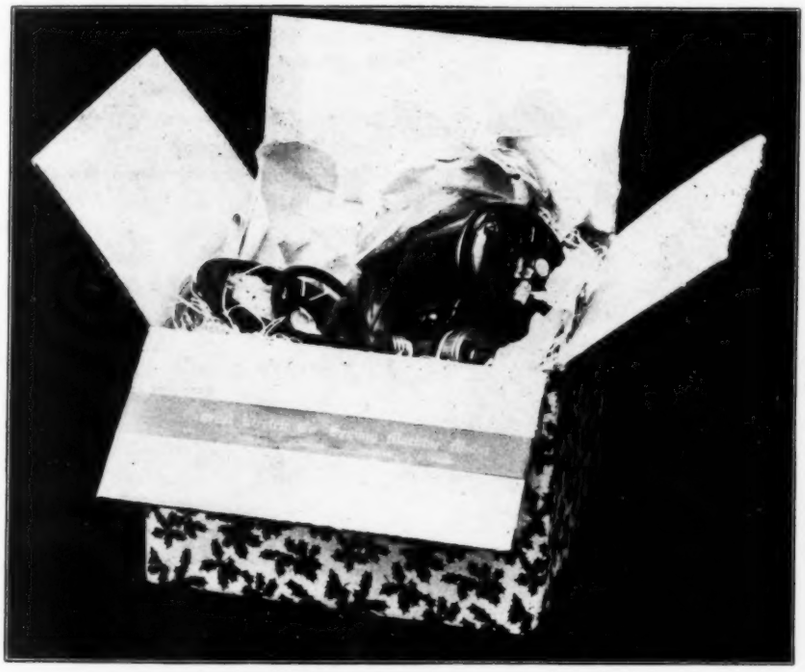
A FEW CHRISTMAS SUGGESTIONS.

Household Devices for Christmas Gifts.

Electric household devices are meeting with a rapidly extending use due to the efforts now being made to lift a large share of the burden of household toil from the shoulders of the housewife and to the demand for a more sanitary method of preparing food.

Naturally these devices are becoming very popular for Christmas gifts. The accompanying illustrations show a number of suggestions for ideal gifts.

General electric heating devices are



SEWING-MACHINE MOTOR IN CHRISTMAS BOX.

Through connection with a switchboard on the surface it is possible to transact the business of the mine by the telephone method. Communication between men underground, and above the mine, once an impossibility, is now an established fact.

all equipped with heating elements that are made of Calorite, a new alloy discovered after years of scientific investigation in the extensive research laboratories of the General Electric Company, which insure uniform and intense heat.

The motor shown in one of the illustrations is compact and of exceptionally rugged design. These devices form very acceptible gifts and in addition the whole household will enjoy the benefits resulting from their use for years to come. A man cannot give his wife a more suitable present than these household devices which make her household duties lighter and more interesting.

A Telephone Party-Line Lockout System.

The rapidly-increasing demand for private service on party lines has opened up a field for a successful lockout system which could be easily installed at the subscriber's station and which would insure absolute privacy without interfering with the efficiency of the line.

These requirements have been fully met in the system described herewith, which, in addition, provides for selective ringing on party lines; permits "locked-out" parties to signal the operator in emergency cases although preventing listening in, etc.

At the party-line subscriber's station, the only thing necessary in order to change any line from public to private services is the addition to each party's telephone on a particular line of a lockout attachment as illustrated in Fig. 1. To connect this attachment the three wires are disconnected from the top of any standard bridging telephone and connected to the top of the attachment instead, then the four wires protruding from the bottom of the attachment are connected to the telephone and that particular station is ready for secret service.

The attachment illustrated consists of a polarized relay, the armature of which actuates a small ratchet wheel which may be set so that a certain number of impulses sent over the line will cut in that particular station. The details of design and construction make it absolutely impossible to cut in a substation on any other than the correct number of impulses. The mechanism of the attachment is shown in Fig. 2.

In order to make the action of the lock-out device accurate, positive and rapid, it became necessary to overcome the residual magnetism of the polarized relay and this was accomplished by using alternate impulses of positive and negative current. The positive impulse from the main battery causes the ratchet wheel to operate and the negative im-

pulse from the low-voltage batteries just sufficient to neutralize the effect of the positive impulse on the saturation of the relay magnet.

When the correct number of impulses to cut in a particular station are sent over the line, the circuit connections are completed, so that the locking relay shown at the bottom of Fig. 2 is actuated to cut in that particular station and keep it there until the conversation is finished and the line cleared by the central operator. From the above we may conclude that the central operator does three things in making a call over a party line lock-out circuit, namely, locks out all the parties on that line; selects and cuts in the desired party, or parties; and rings the desired party, or parties, simultaneously. It is obvious, therefore, that each party is called with a single ring, and that the use of code ringing is eliminated.

Each attachment is equipped with a small push button which will permit a lock-out subscriber to signal central in case of emergency. This signal, it will be noted, does not interfere in any way with an ensuring conversation, but merely operates the drop at the switchboard, when the telephone generator crank is turned. This, of course, notifies central and she can come in on the line and investigate the reason for the call.

The central-office apparatus is also supplied in the form of an attachment

FIG. 2.—VIEW OF ATTACHMENT SHOWING MECHANISM.

that may be connected to any switchboard and its simplicity is, if anything, more pronounced than that of the substation attachment: It consists of a selector key to which is attached a piece of cable for making connections to the main and low-voltage batteries and to each cord circuit on the switchboard.

Fig. 3 illustrates one of these selector keys. By the use of this selector key, which is four inches in diameter, any or all parties on the party line may be called. The switching key is arranged to be set for either magneto or common battery and may be used on a

FIG. 1.—ATTACHMENT FOR SUBSCRIBERS' STATION.

switchboard interchangeably with these two systems, according to the position of the switching-key lever. Where the service is all of one kind, the lever may be locked for either magneto or common battery.

One position of the switching key sets the connections so that the ringing machine may do the ringing, while in the other position the ringing machine

FIG. 3.—SELECTOR KEY.

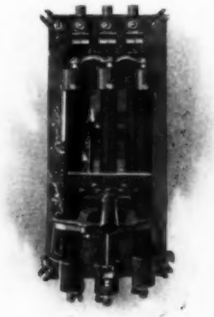
is cut off and the hand generator substituted.

These selector keys are furnished in two designs, one for mounting direct on the keyshelf and the other for mounting on the face of the board. One of these selectors is required for each operator's position that is equipped with party-line lock-out systems.

Direct and Alternating-Current Motor Starters and Mill Controllers.

An improved line of direct and alternating-current motor starters, and mill and crane controllers have recently been placed on the market by the Allen-Bradley Company, Milwaukee, Wis. These devices are of the carbon compression type, and the resistance is in the form of columns of prepared graphite discs, the resistance being secured through the imperfect contact between the discs. This contact resistance varies with pressure, and the resistance changes in the devices are caused by subjecting the resistance columns to various degrees of compression. The columns are enclosed within an insulated steel tube, which is provided with suitable terminals and a plunger for transmitting the pressure to the discs contained therein. These graphite discs are well adapted for rheostatic service, as they will not crush or break, are not affected by any temperature encountered in rheostatic service, cannot be fused, will not corrode, and are not changed materially by years of service.

Whatever switching is necessary in combination with these devices, is accomplished by suitable contacts attached to the compression mechanism. A thirty-five horsepower Allen-Bradley, direct-current motor starter is shown in the accompanying illustrations. The tube containing the resister column is mounted on the front of the slate pan-



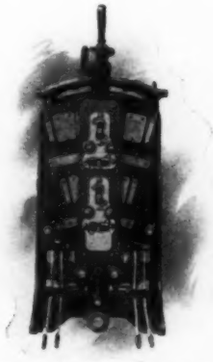
ALLEN-BRADLEY STARTER FOR SLIP-RING INDUCTION MOTORS.

el. The operating lever is of the ordinary form, and the compression of the resister column, and the consequent cutting out of the resistance is brought about by raising the lever, as is done in the ordinary type of starter. The starting of the motor is accomplished without jerks or flashing. These starters are extremely durable.

The Allen-Bradley mill and crane controllers, shown in the illustration, embody the described compression resister, and are built to withstand the most severe controller service. Every detail of their design has been given the benefit of years of experience, in connection with this class of apparatus.

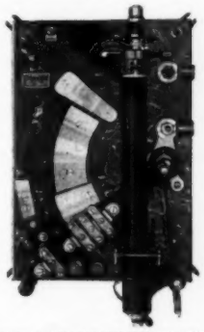
The Allen-Bradley alternating-current motor starters for slip-ring, and squirrel-cage induction motors, are designed with the same care in regard to mechanical and electrical detail, as is the direct-current apparatus. The mechanical pressure exerted upon the resisters in the several phases, is equalized by means of suitable mechanism, so that the resistance in each of the phases is always the same at any instance, and unbalancing is thereby prevented.

The squirrel-cage starter is so designed that when the switch is thrown into the starting position, the elongation of the resistance columns, due to heat expansion, is retarded in such a manner as to gradually compress the resister columns, which results in automatically reducing their resistance until the motor starts. After the motor has reached its normal speed, the switch is thrown into the running position, at which point the running fuses are brought into the circuit. The cut shows the Allen-Bradley squirrel-cage starter with a conventional switch. Different types of switches can be employed to meet varying conditions. The even and gradual current flow when starting the motor, the increased torque when the motor is accelerating, together with its simplicity and ruggedness, make the Allen-Bradley rheostatic starter in many cases, when the motors are small or medium sized, a more serviceable device than the cumbersome and complicated auto starter.



TWENTY-FIVE HORSEPOWER MILL CONTROLLER.

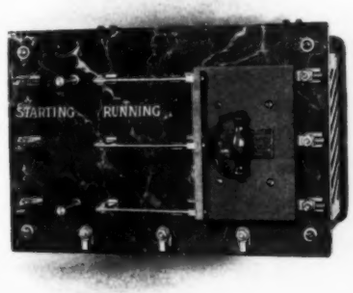
These rheostatic starters require in their operation about fifteen per cent more power from the line than is demanded of the auto starter, but the actual current supply to the motor is no greater and often times less, as the starter automatically prevents more



THIRTY-FIVE HORSEPOWER DIRECT-CURRENT MOTOR STARTER.

current from flowing than is absolutely necessary to start the load, even though the load may vary at different starting periods. As the wattless component of the line current is less with the rheostatic starter, the disturbance to the line voltage is no greater than with the auto starter. It will be noted also that the running fuses are protected during the acceleration of the motor, so the greater line current is seldom an objection. This type of starter is made in capacities up to twenty-five horsepower.

The Allen-Bradley slip-ring starter is equally simple and durable in its construction, as is shown in the illustration. The starting of the motor is done manually by means of the operating lever, there being no automatic action in connection with this device. It possesses all of the good features of the Allen-Bradley direct-current starters, the most notable being that of causing even acceleration of the motor.



ALLEN-BRADLEY STARTER FOR SQUIRREL-CAGE INDUCTION MOTORS.

New Sign-Lamp and House-Lighting Transformer.

Ever since the Mazda lamp was placed on the market there has been a demand for low-voltage transformers to supply current at from ten to thirty volts. A transformer for this purpose deserves better care in its design and manufacture than it has usually received. Its efficiency should be high since it is to supply high-efficiency lamps. Its insulation should be thorough though it is built for low-voltages for it will very likely be mounted in-doors when there is a fire risk. For the same reason it should be mounted in a substantial case of good appearance.

Realizing all of the above points, the Packard Electric Company, Warren, O., has lately improved and amplified its line of Mazda sign and house-lighting transformers, and it is believed that the new type embodies all of the features desirable in a piece of apparatus of this kind.

A view of one of these transformers is shown herewith. The case is of cast-iron and of exceptionally neat design. It is filled with a solid compound which permits of the transformer being mounted in any position.

The insulation and general construction are the same as for the Packard transformers for higher voltages. An especial feature is their high efficiency.

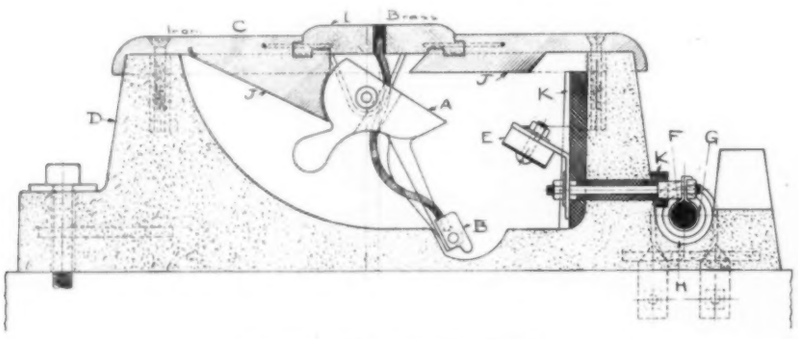
These transformers are furnished in one-tenth, one-eighth, one-quarter, one-third, one-half, two-thirds, one and one and one-half kilowatt sizes for either 110 or 220 volts primary and for secondary voltages of ten to thirty.

PACKARD SIGN-LAMP AND HOUSE-LIGHTING TRNSFORMERS.

The Simplex Surface Contact System.

The efficient operation of cars by the surface contact method has been accomplished by the Simplex Surface Contact Company, Williamsport, Pa., on a part of the Lewisburg, Milton & Watsontown Railway tracks at Milton, Pa. This system has corrected the features which resulted in the partial failure of other systems.

To the casual observer the Simplex system when installed appears to be nothing more than a series of metal plates in the center of the track. These plates are the covers of contact boxes which rest on the cross ties and are thoroughly insulated from the boxes proper, and being slightly oval and the edges flush with the paving, offer no hindrance to traffic. The mechanism within the box as shown in the accompanying diagram, consists of two cast-iron poles, *J*, between which is suspended an armature *A*, with a switching brass contact, *B*. The electric current is transmitted by insulated cable, *F*, enclosed in a conduit, *H*, running parallel with the rails with an insulated connection into each box, terminating at the brush, *E*. The box and conduit are thoroughly sealed, thereby excluding water or other foreign material.



MECHANISM OF CONTACT BOX.

Each car is equipped with two magnetic bars suspended lengthwise underneath the car and a few inches above the level of the tops of the box. These parts are magnetized by a series of coils which are maintained by by-pathing a part of the electric current used in the operation of the car.

Between the two magnetic bars is suspended a copper collecting shoe, which, like the magnetic bars, is of a length covering two boxes at all times. The magnetic bars, however, being slightly longer than the collecting shoe, maintain the electric current until the collecting shoe entirely passes off the box, which eliminates any possibility of arcing inside the box. The collecting shoe, of course, acts in the same capacity as does the shoe in the third-rail system.

The operation is as follows: the magnetic bars carried on the cars operate the switch within the box imbedded in the street. This magnetic operation brings the switch in contact with the brush within the box which is connected to the feed wire. This of course charges the lid of the box with electricity and the collecting shoe beneath the car which touches the tops of the boxes conveys the electricity to the motors. From the fact that the car is in contact with two boxes at all times there is double assurance of a continuous current of electricity supplied to the moving car, and as the operation of the switch within the box is caused by magnetism, only the lids of boxes directly beneath the car are alive, which makes it possible for horses or pedestrians to travel over them with entire safety.

The Simplex system has been reduced to the fewest possible parts, each of which is of a material as cheap as it is substantial. Reports of the operation of the Simplex system covered day by day from April 28, 1910, to October 4, show that the system has never been out of order to an extent that would prevent the operation of the car with but one exception where the car jumped the track but was put on the rails again through the use of the Simplex system alone. The coils carried on the car which energize the magnetic shoes were designed especially for the Simplex system. These coils have had no repair since they were placed on the car and they have been in operation continuously.

It would be natural to suppose that the greatest wear would occur at the point of contact within the box, considering the three inches separation at normal. In this series of tests, however, it is claimed that the contacts have shown scarcely any wear. Neither the collecting shoe coming in contact with the brass insert in the lid, nor the lid itself has shown any appreciable wear.

A contract was recently closed for the construction of ten and a half miles of this system which will be operated between Montandon and Mifflinburg over the Lewisburg-Tyrone branch of the Pennsylvania Railroad. The current to be used will be generated at Milton, Pa., and conveyed across country to a substation which will be located in the middle of the line.

It is the purpose to have the electric system work in conjunction with steam, insofar as passenger traffic is concerned. Work on this road it is stated will be started within the next few weeks and it is the expectation to have the line completed before April 1, weather conditions permitting.

VIEW OF CAR ON TRACK.

One of the accompanying photographs shows the road-bed exposing the tops of the boxes.

Large Order for Motors.

The Republic Iron & Steel Company has closed a contract with the Westinghouse Electric & Manufacturing Company for seventy-nine crane and mill motors, aggregating about 5,000 horsepower. The motors will be used in the plant of the Republic company at Youngstown, O., to replace most of the shafting and belts used by the company. The contract also includes magnetic controllers for the large motors and manually-operated controllers for the smaller motors.

The Fox-Multax Flame Arc Lamp.

The flaming arc lamp is now accepted as a standard illuminant for certain classes of lighting. The advent of the long-burning flaming arc lamps is of great importance in this connection and is doing much towards widening the field of these illuminants.

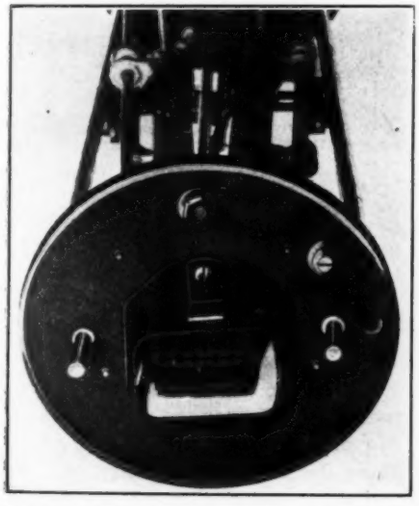
A flaming arc lamp, embodying long-burning features together with extreme simplicity of construction is being placed on the market by the Fox-Multax Electric Company, New York, N. Y.

The carbons are of the bridge core type, which is clearly shown by the accompanying illustration, the outer wall being of solid carbon of a high degree of purity and the cores and bridge of mineral salts.

The illustration herewith, shows the interior of the lamp and with the carbons partially consumed. There are four carbon holders, all connected to a common carrier, so that all four carbons move downward together. The two negative carbons are arranged in a V shape, so that their ends meet at a certain point in the arc chamber, which naturally prevents the carbons from passing down further, as they practically come to a jam and in this way the position of the carbons is self-sustained. The positive carbons are arranged in a similar manner, and thus also self-sustain their position in the arc chamber. It will now be observed that although there are four carbons in the lamp they really act as a single negative and a single positive carbon in the arc chamber and when operating the lamp has but one arc burning and this arc travels back and forth from one core to the next having steady passage by reason of the bridge core. As the carbon burns away a sneak feed occurs and it might be said that the carbon tips are always at a fixed position in the arc chamber as this disintegrating feed causes a very small amount at a time.

FOX-MULTAL FLAME ARC LAMP, WITH COVER REMOVED.

The two negative carbons are moved away from the positive carbons by a slipper block which is actuated by the solenoids, the latter being contained in an upper compartment of the lamp, and when the current is switched on the arc forms immediately and the series coil causes the slipper block to move the negative carbon away from the positive carbon and the shunt and series coils then cause the arc to be maintained at constant values.



VIEW OF MECHANISM SHOWING CARBONS.

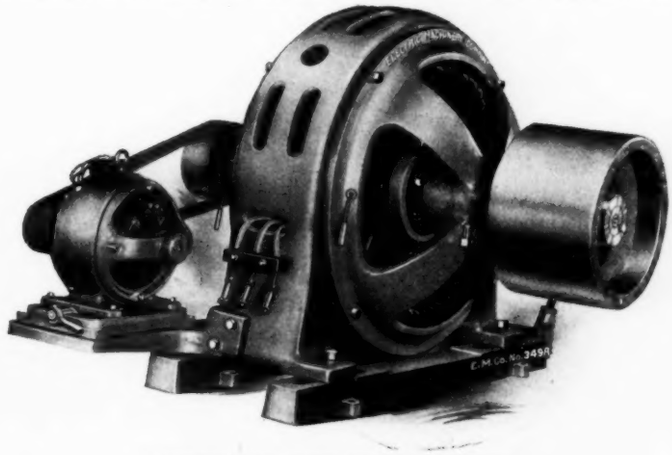
Alternators with Direct-Attached Belted Exciters.

The modern electric light plant in cities of moderate size generally contains belted alternators of capacities of 200 kilovolt-amperes or less. These alternators are generally excited by a small direct-current belted exciter, which is installed on a separate foundation and treated as a separate machine driven by a belt from a pulley on the alternator shaft.

The operator invariably experiences difficulty in maintaining proper belt tension. The adjustment of the main alternator belt disturbs the exciter belt and frequently results in hot box on the exciter.

To overcome these difficulties the Electric Machinery Company, Minneapolis, Minn., has recently put on the market moderate sized alternators with direct-attached belted exciters, as shown in the accompanying cut.

This type of alternator with exciter mounted on a cast-iron bracket, which is attached directly to the alternator frame so as to move with it, eliminates the ever-present difficulty experienced by operators in maintaining proper belt tension on both the main belt and the exciter belt, so as not to endanger the exciter bearing in case the exciter belt is too tight, or, on the other hand, allow the exciter belt to slip off and interrupt service if it is too loose. Tightening or loosening the main alternator belt has no effect on the exciter belt.



ALTERNATOR WITH BELTED EXCITER.

These alternators are furnished in sizes from thirty to 180 kilovolt-amperes, operating at from 600 to 1,200 revolutions per minute.

The belt centers are shorter than in the case of separately mounted exciters,

but the two pulleys are made amply large and of ample width of face so there is no difficulty. The exciter is the standard spherical-type exciter and the alternator is the standard spherical-type alternator.

Each alternator rail has its own ratchet head and the two ratchets are locked together by a crossbar so as to be operated simultaneously by a single lever. The machine may be pushed or pulled by these ratchets by simply throwing the pawls.

According to the manufacturer, this will cost the purchaser less than to install the exciter on a separate foundation with a long belt which he will have to furnish, and will also secure to the exciter a good deal better attention from the operator, and also require much less floor space than the usual way.

Electric Sign Flashers.

The electric sign is being advocated, by every progressive central station, as one of the most effective and economical means of advertising. In view of the remarkable progress being made in this field, due to the activities of the central stations there has been a corresponding development in the manufacture of sign flashers and accessories, it being possible today to create almost any spectacular effect desired.

There are two distinctive advantages in favor of the use of electric sign flashers. First, it compels the passer-by to look at the sign which, of course, is the primary reason for the installation of a sign, and secondly the cost of current is reduced an appreciable extent.

In the accompanying illustrations are shown several types of sign flashers which are meeting with pronounced success in the innumerable installations in which they figure.

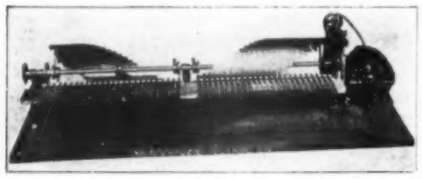


FIG. 1—CRAWLING-CHASER TYPE.

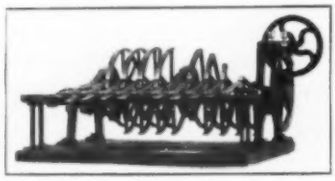


FIG. 4—BRUSH-TYPE FLASHER.

For producing such effects as crawling snakes, jumping rabbits, etc., wherein one apparently animated object chases another around the border of a sign, the flasher shown in Fig. 1 is adapted. The illusion is accomplished by wiring each opposite lamp in the sign on one wire, making half the number of circuits that there are lamps in the border. Almost eight or ten circuits are lighted at one time, and when the ninth is connected the first is disconnected. The capacity of these flashers is limited to two amperes per circuit.

For capacities from fifty amperes up the series-carbon flasher shown in Fig. 2 is particularly adapted. This flasher breaks the line in series in three or more places at once, making it necessary for the current to jump that many air gaps in order to hold an arc.

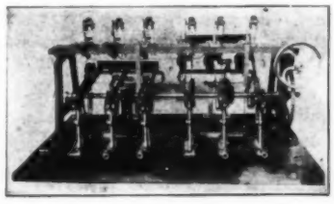


FIG. 2—SERIES-CARBON TYPE.

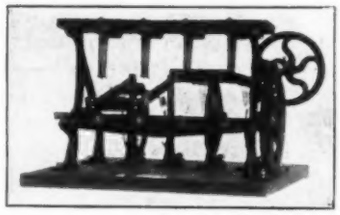


FIG. 5—KNIFE-TYPE FLASHER.

The flasher shown in Fig. 3 is known as the high-speed type and probably produces the most spectacular effects of any except the large combination type. Falling effects such as fountains, streams of liquids, foam, smoke, fire, steam, cloud effects, revolving wheels, etc., are produced with this machine. These flashers operate at a speed of approximately 200 breaks per minute and will carry twenty four-candlepower lamps per switch.

The brush-type flasher is shown in Fig. 4. This is a moderate priced flasher, especially designed for spelling out signs one letter at a time, or work of a similar nature. The cams, constituting a drum on this machine, are of very heavy construction. The brushes are of pure copper and are provided with a special brush holder that prevents a loose contact or abnormal burning.

A new flasher which has recently been placed on the market is shown in Fig. 5. It is known as the knife-type flasher and is a moderate priced, substantially built flasher throughout. It is mounted on a three-fourths inch slate base, steel worms and machine-cut gears are used and it requires no other attention than oiling once a week.

In Fig. 6 is shown a combination flasher which is designed for large spectacular signs such as sky-rockets, fireworks, fountains, etc., in combination with reading matter. They can be made to produce almost any conceivable combination of effects.

The flashers illustrated and described herewith are manufactured by the Reynolds Dull Flasher Company, 152 Fifth Avenue, Chicago, Ill.

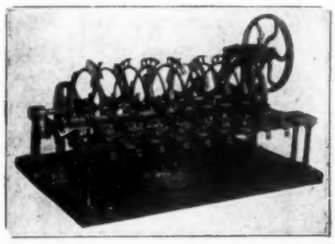


FIG. 3—HIGH-SPEED TYPE.

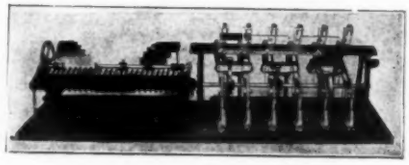


FIG. 6—COMBINATION FLASHER.

Electric Cranes on Ore Vessel.

The *Vollrath Tham*, one of a fleet of vessels engaged in the Swedish ore-carrying trade, has ten electric cranes, five on each side of the ship. Each crane has a lifting capacity of 5,000 pounds, a hoisting speed of seventy-five feet per minute, and will handle from forty to fifty tons per hour. An entire cargo of 8,200 tons has been discharged in forty-seven working hours by a crew of fifteen men, using only five of the cranes. The vessel contains her own electric generating equipment.

Current Electrical News

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, NOVEMBER 25.—A project is on foot for a railroad line in the Jaen province of Spain on which it is probable that electric traction will be used. The plans are now being drawn up by a French company. The new line will run from the north to south of the province, and it is expected to carry a considerable traffic. It will run from Pedro Abad to Martos, and it is probable that it will be continued by a new section running from Alcandete to Grenada. It passes through an olive growing and cereal region.

There is to be built a suburban line running from the Place de la Republic in Paris to St. Denis. The franchise for the road has already been awarded, and work is to be commenced at the suburban end very shortly. Electric traction will be substituted for steam on the line which runs between Sevran and Claye. In Algeria there is a project for an electric tramway from Oran to El Ancor. The Lyons Syndicate, among others, has applied for the franchise. It is probable that the tramway now running from Algiers to the suburban locality of Chateauneuf will be extended as far as Bouzarea.

A new turbine plant is to be erected on the Bourne River, in the Dauphiné region of France and it will be above the 4,000-horsepower Bournillon plant, working in connection with it so as to extend the power network. The company which owns the Bournillon plant lately purchased the Froment station at Auberives which also worked on a power network. As to the new turbine plant, it will have an intake flume entirely cut in the rock; and its output will at least equal what the Bournillon plant now gives. It has just been announced that the Brown-Boveri firm of Baden, Switzerland, has been consolidated until the Alioth Company of Basle and has also taken over the Isaria Zahlerwerke (Meter Company) of Munich.

Work is being actively carried out upon the electrical equipment of the Lötschburg railroad, Switzerland, upon the Spiez-Frutigen section. Tests will be made on this section in order to obtain data for operating the entire line. Two types of experimental locomotives are now being built. One of them is constructed by the Swiss Oeslikon firm and the second by the Allgeneine Gesellschaft of Berlin.

The French Thomson-Houston firm is engaged in extensive operations in Egypt. The Egyptian Thomson-Houston Company, which is a branch of the former, has lately secured the contract for the electric lighting of the town of Assiout. It already obtained the rights for the lighting of Zagazig during the last year. All of the material used in this work will be supplied from the Paris shops of the Company.

Among recent Italian projects is the eighty-mile electric railroad running from Rome to Frasinone. Another railroad line passes between Gallarate and Magnago, in the Italian lake region, we mention another between Argegno and Lanzo. Electric tramways are planned from Sperzia to Cadunare and from Chiavasso to Biella. A. DE C.

CANADA.

(Special Correspondence.)

OTTAWA, ONT., DECEMBER 3.—On November 1 the pay-as-you-enter car system went into operation on all street car lines of Toronto.

The City Council of Hamilton, Ont., has asked the Hydro-Electric Commission to extend the time, in which the City can enter into full co-operative contract with the Commission, to December 31, 1911.

Contractors constructing the dam at Farnham, Que., are employing additional help in order to complete the work by March next, when the Yamaska River will supply the municipality with 600 horsepower. The work is costing the town of Farnham $100,000.

Hon. Adam Beck, Ontario minister of power, anonunces that before the end of the present month, the entire 290 miles of hydro-electric power line, carrying Niagara energy at 110,000 volts to all the chief centers of Ontario west of and including Toronto, will be completed and in operation. The Government installation is the greatest in the world today.

The city of Port Arthur, Ont., is now receiving its first power direct from Kakabeka Falls, over the new transmission line built by the Ontario Hydro-Electric Commission, on the contract entered into ten months ago. The supply, at present, is 600 horsepower.

The City Council of Sherbrooke, Que., has decided to develop the "drop-off" power on the Magog River. It is estimated that the cost will be $70,000. According to the plans prepared, there will be about 2,600 horsepower developed. It was also decided to call for tenders for the purchase of the power that the City owns of the St. Francis River, at Westbury.

The directors of the Electric Company of London, Ont., will ask the City to buy them out for the sum of $200,000. A by-law will probably be submitted to the taxpayers of the city in January next to authorize the purchase. A year ago the Company wanted $440,000 for its plant. The present price asked, it is pointed out, will not leave much for the shareholders of the common stock as there are over $100,000 of debentures to be provided for.

The minimum flow of development of Canada's water powers is estimated at nearly 26,000,000 horsepower. These are the figures of J. B. Challies, of the department of the interior at Ottawa. Mr. Challies will revise this estimate shortly, when it is anticipated that the water powers of the Dominion will be found to be considerably greater than this total. A careful calculation shows that the maintenance of one horsepower per annum from steam power involves a consumption of 21.9 tons of coal. On this basis, therefore, the available water powers of the Dominion as above estimated, represent a combined energy which, if it were generated by coal and steam, would involve a coal consumption of 562,455,633 tons per annum. The summary of the available water powers of the Dominion, at the minimum flow of development, together with the amount at present developed, is as follows: In the Yukon Territory, 470,000 horsepower; in British Columbia, 2,065, 500 of which 73,100 horsepower is at present developed; Alberta, 1,144,000, of which 1,330 is the present development, Saskatchewan, 500,000; Manitoba, 504,000, with 18,000 now developed; Northwest Territories, 600,000; Ontario, 3,129,168, having a present development of 331,157; Quebec, 17,075,939, and 50,000 developed; New Brunswick, 150,000; Nova Scotia, 54,300 of which there is a present development of 13,300 horsepower. W.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The Kenosha Electric Railway Company has brought a case before the State Supreme Court involving the constitutionality of the convenience and necessity provision of the public utilities law and seriously involving the powers of the Wisconsin Railroad Commission. It is held by the Electric Railway Company that the provision is unconstitutional in that it gives the Railroad Commission legislative power. This provision says that "no public utility engaged in the production and delivery of heat, light, water or power shall operate in any municipality where already in operation is a similar public utility, unless it shall first obtain from the Railroad Commission a certificate to the effect that public convenience and necessity warrants the operation of the second utility."

The state's attorney contends that the powers given the Commission under this act are merely administrative and that the Commission simply determines the facts upon which the legislature has previously decided the law shall operate.

In case the convenience and necessity provision of the public utilities law is declared unconstitutional, the indeterminate permit provision would also be made void for the same reasons.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

During the recent rehearing of the application of the Buffalo, Rochester and Eastern Railroad for a franchise to construct a road across the State of New York from Troy to Buffalo, William H. Elliott, signal engineer of the New York Central Railroad Company, testified that the road with which he is connected is constructing a new signal system from Croton to Buffalo, which will eventually cost $3,000,000. This reconstruction will shorten the blocks to an average length of a mile. At present they are about 8,700 feet long, on an average. Mr. Elliott stated that the average daily number of trains now operated on the main line tracks is fifty-eight on tracks one and two, passenger, and thirty on tracks three and four, freight. When the automatic signal equipment is completed, he said that it would increase the capacity of the Western Division twenty-five per cent, and the Hudson Division 100 per cent. He added that if it were possible to still further shorten the blocks to a length of 4,200 feet, the carrying capacity of the road would be increased 200 per cent more than at present.

The Public Service Commission has granted the petition of the Elmira Light and Railroad Company for authority to extend its street surface railroad on Pennsylvania Avenue to the city of Elmira, to the southerly city line, thence along the route on Pennsylvania Avenue to the town of Southport to Southport Corners.

The Public Commission has also authorized the Middleport Gas and Electric Light Company to exercise franchises granted for the furnishing of electric lighting to the town of Royalton, Niagara County, N. Y.

The Commission is holding hearings at Albany, New York, Syracuse and Buffalo. At Albany, on December 6, the application of Hoosac River Electric Light & Power Company for permission to construct its lines in the town of Pittstown, Rensselaer County, and to issue capital stock was heard. On December 7, at Albany, companies in the state which have been ordered to show cause why they should not manufacture and distribute gas in accordance with the prescribed standards of illuminating power and purity was heard. The companies upon which orders have been served are: Waterville Gas & Electric Company; Watertown Light & Power Company; Sea Cliff & Glen Cove Gas Company; United Gas, Electric Light & Fuel Company, of Sandy Hill; Rome Gas, Electric Light & Power Company; Peoples Gas & Electric Company, of Oswego; Newburgh Light, Heat & Power Company; Half Moon Light, Heat & Power Company, of Mechanicville; Malone Light & Power Company; Glens Falls Gas & Electric Company; Homer & Cortland Gas Light Company; Central New York Power Company, of Utica. T.

LIGHTING AND POWER.

(Special Correspondence.)

LETCHER, S. D.—A stock company is to install an electric light plant at once. C.

WAUSAU, WIS.—The installation of a municipal electric light plant is being agitated. C.

PALACIOS, TEX.—C. D. Deal, of Colorado Springs, Colo., has purchased the local electric light plant. P.

GRAPELAND, TEX.—G. W. Johnson & Company, of Kansas City, propose to install an electric light plant here. P.

WEBSTER CITY IOWA.—The contract for the installation of a light and power plant has been let at $50,000. C.

CULBERTSON, MONT.—W. E. Pierce has applied to the Council for a franchise to install an electric light plant. C.

BERTHOLD, N. D.—John K. Moore, of Minot, N. D., has been granted a franchise to install an electric light plant. C.

BELLE PLAINE, IOWA.—Construction has been started on the municipal electric light plant which is to cost $20,000. C.

RED OAK, IOWA.—The Red Oak Electric Company will build a line to Stanton, Iowa, and will furnish that town with light. C.

DULUTH, MINN.—The Council proposes to secure legislation whereby the City can install a municipal electric light plant. C.

HAMBURG, IOWA.—A vote will be taken December 12 on granting a franchise for the installation of an electric light plant in this place. C.

CHINOOK, MONT.—The Chinook Light & Power Company has been incorporated by Thomas O'Hanlon, A. S. Lohma and E. S. Sweet.

WAPELLO, IOWA.—Utt Brothers are considering the conversion of the old mill race into a water power at an expense of $300,000. C.

MOOSE LAKE, MINN.—A franchise has been granted to the Cloquet Electric Company to extend its wires from Cloquet to Moose Lake. C.

MUSSELSHELL, MONT.—Handel Brothers are promoting the installation of an electric light plant with a capacity of 600 thirty-two-candlepower lamps. C.

ALBANY, CAL.—The Great Western Power Company has been granted a franchise to operate its electric-power system here and to the north of Berkeley. A.

THIEF RIVER FALLS, MINN.—The City will construct a dam across Red Lake River, four miles south, in the spring, and install an electric light and power plant. C.

MAIDEN ROCK, WIS.—At a special meeting of the Village Council steps were taken toward the establishment of a municipal electric-light system in Maiden Rock.

KENTON, O.—The Hardin-Wyandot Lighting Company has been incorporated with a capital of $10,000 by W. B. Whiting, C. C. Owens, Sterling Newall and others.

ATLANTIC, IOWA.—The contract for 10,000 sixteen-candlepower light bulbs was let by the city council to the Electric Appliance Company, of Chicago, Ill., for $1,600. C.

JOHNSONVILLE, N. Y.—The work of wiring the village for electric lights is well under way, and it is expected that the system will be completely installed by December 15.

SEYMOUR, IND.—The roundhouse and new repair shops of the Baltimore & Ohio South Western Railroad now building in this city, will be operated by electric power throughout. S.

MARSHALLTOWN, IOWA.—The Council has opened bids for the installation of the machinery for the steam power electric light and pumping station, ranging from the $6,800 to $8,900. C.

PLATTE, S. D.—The City Council has acted favorably upon a franchise giving F. J. Miller the right either to purchase the present electric light system here, or install a new plant.

NORWALK, O.—The Wheeling & Lake Erie Railroad Company is, according to a recent agreement, to furnish electric light to this village. Work on wiring will commence at once.

ONTARIO, CAL.—The San Antonio Water Company has begun the work of increasing its power capacity at sub-station No. 1. The alterations involved will be made at a cost of about $20,000.

RICHMOND, CAL.—H. B. Kinney, manager of the Richmond Light & Power Company, announces that his company will soon begin the complete reconstruction of its power plant in this city.

BONAPARTE, IOWA.—S. E. Irish, of Keosauqua, Iowa, has purchased the Meek dam and will organize a company to rebuild it and equip it with electrical apparatus to develop 1,200-horsepower.

BAYFIELD, WIS.—The Board of Water and Light Commissioners will erect a boiler house, 47 by 64 feet in size and will install two steam boilers, at the water and light plant at a cost of $8,000. C.

PEORIA, ILL.—A contract has been let for the erection of a new electric light plant near the site of the present one. The plant is to contain two 500-horsepower engines and suitable generators.

RACINE, WIS.—The Belle City Malleable Iron Company factory buildings have been equipped throughout with a modern electric light plant, an improvement which has been contemplated for a long time.

EGAN, S. D.—A movement has been inaugurated here to establish a municipal electric light system, and it is believed a special election will soon be called to vote upon the issuance of the necessary bonds.

OROVILLE, CAL.—The Great Western Power Company is about to enlarge its Island Bar power house. There are now four generators in use there and the Company announces that another is to be added. A.

LEESBURG, IND.—The Leesburg Light & Water Company has been incorporated with a capital of $10,000. The incorporators are Frank Bortz, W. A. Kohler, W. H. Stanley, H. E. Kinsey, and Charles Gawthrope.

COUDERAY, WIS.—Work on the power proposition of the Arpin Lumber Company on the Chippewa River is progressing rapidly and it is probable that the hydroelectric plant will be in operation by the coming summer.

SYLVA, N. C.—An electric plant is to be installed at the Harris Roller Mills, at Dillsboro. The machinery has been ordered and the plant will be installed at once. The plant will furnish power for Dillsboro, Sylva and the tannery.

CLEVELAND, O.—A permit for the erection of a $230,000 power plant for the Cleveland Electric Illuminating Company has been issued by the building inspector here. The new building will be located at 720 East Seventieth Street.

VICTORIA, TEX.—Under the terms of the lighting contract recently entered into by the City, sixteen-candlepower lamps are to replace the eight-candlepower ones formerly in use. The Victoria Electric Light Company supplies the power.

TACOMA, WASH.—The light and water department will call for bids for the city's Nisqually power plant by December 15. The estimated cost of the remaining work is $1,100,500. Practically all of the work will be let in a single contract. C.

KANSAS CITY, MO.—On account of a shortage of money many streets not now illuminated will remain without light until April. The $190,000 which was appropriated for the present fiscal year has already been used and there is an apparent deficit of $9,000.

RICHMOND, VA.—The Virginia Railway and Power Company, of this city, has been granted a permit for the construction of a blacksmith shop for use in connection with its large electrical interests here, the same to cost from $4,000 to $5,000, being of steel and concrete. L.

CLARKSTON, IDAHO.—It is announced that a contract has been let to Charles C. Moore & Company, of San Francisco, and the General Electric Company for the installation of a new steam-driven electric generating station here. The plant is to cost about $100,000.

INTAKE, CAL.—Work on the Great Western Power Company's dam here, was completed recently and the reservoir is now in working order. The dam is 86 feet high from the bed of the river and 285 feet long on top. It is 75 feet wide at its base and of solid rock and cement. A.

FAIRMONT, MINN.—The Electric Light & Water Commission has let the contract for the Minneapolis Steel & Machinery Company, Minneapolis, for the installation of a 400-horsepower engine for $21,985, to the Allis-Chalmers Company, for a new pump, motor, etc., at $2,885. C.

ATCHISON, KAN.—The town of Troy, in the northeastern part of the state, is now receiving power from the plant of the Atchison Power Company, of this city. In the town of Wetmore a gasoline-driven generating plant is to be installed, for which bids have already been opened.

INDIANAPOLIS, IND.—Local electricians have prepared a bill to be introduced in the Legislation to regulate "persons, firms and corporations installing wires or apparatus conveying electric current for any purpose." Underwriters are encouraging the electricians on the belief that faulty wiring is the cause of many fires. S.

GREENWOOD, S. C.—The superintendent of the local water and lighting system, J. A. Sproles, has announced the successful boring of a 300-foot artesian well, which tested at the power plant, showed a daily flow of half million gallons, thus doubling the former water supply of the town and plant. L.

WATERLOO, IOWA.—The Central Heating Company of this city has filed notice with the Secretary of State of enlargement of its object to include the manufacture and sale of electric power and of an increase from $15,000 to $40,000 in capital stock. C. F. Fowler is president and A. M. Place is secretary. Z.

KINGMAN, ARIZ.—The Desert Power & Water Company is doubling the capacity of its electric power plant here at a cost of about $75,000, and is extending one of its supply lines six miles, making its system aggregate about thirty-two miles. It is expected to have the addition to the plant ready for operation not later than January 1.

TACOMA, WASH.—Savage & Nichols have been awarded the contract for building the upper portion of the Nisqually power system. The work on which the bids have been let is the building of a dam in the Nisqually River and of a 10,000-foot tunnel. The Nisqually Company will soon let a contract for the transmission line.

ANSLEY, NEB.—A special election was held recently at which $5,000 bonds were voted for putting in a city electric light plant. Only nine votes were cast against the proposition. Ansley had the first electric light plant in Custer County, which was put in in 1892, but burned three years ago. Another plant was put in which burned last spring.

WONDER, CAL.—The Mona Electric Power Company has completed surveys for a seventy-five mile power transmission line from Lucky Boy to Wonder, and it is announced that contracts will be let at once. It is intended to have the line completed by the middle of February, 1911. A voltage of 60,000 will be carried, the power being distributed mainly to mining companies. A.

MAUMEE, O.—Application has been filed in the Common Pleas Court at Toledo asking the appointment of a receiver for the Maumee Light & Power Company. A. A. Bemis, an attorney, of Cleveland, who filed the petition charges that the Company transferred its assets to the Suburban Company, a new organization, last April for the purpose of hindering and defrauding those who were its creditors. H.

SPRINGFIELD, ORE.—The Northern Idaho & Montana Power Company has bought a tract in this city on which it has begun the erection of a general sub-station which will be made the distributing point for the entire Willamette Valley. A two-story brick building is under construction, to be occupied about the first of next March. The machinery to be installed will cost approximately $150,000. A.

SUPERIOR, WIS.—The Great Northern Power Company, which operates a big hydroelectric plant at Thompson, Minn., on the St. Louis River, announces its intention of spending $250,000 in building a power-transmission line and distributing station in Superior. The concern now supplies Superior industries from its plant at Duluth, but that plant is inadequate on account of an increasing demand here.

HARRISBURG, PA.—Sixteen electric companies were recently granted state charters. Eight of the charters were granted to Walter A. Rigg, C. L. Roller and H. H. Riegel, of Reading, whose companies have $5,000 capital each and bear these names: Edison of Boyertown, Lower Alsace Township, Amity Township, Colebrookdale Township, Douglas Township, Exeter Township, Earl Township and Oley Township.

ORONO, ME.—The Penobscot Realty Company, which has purchased the power site and nearly the entire holdings of the James Walker Company, in Orono, has already commenced work in connection with the erection in the spring of a new electrical power plant that will generate between 3,000 and 5,000 horsepower. According to the plans, which are not yet complete, the new plant will cost in the vicinity of $300,000.

MOORESVILLE, IND.—In consideration of $19,500, Ben. R. Mowry, receiver, for the Mooresville light and power plant, was sold December 1, to Harry J. Stroops, of Chicago. The Mooresville plant, known as the Public Service Company was running behind in a business way and was placed in the hands of a receiver. It is understood the new owner will make needed improvements and install some new machinery in the plant. S.

INDIANAPOLIS, IND.—Engineers who were employed several months ago to report on the advisability of building and equipping a heat, water, light and power plant for the exclusive purpose of supplying the State House, the Soldiers Monument and other nearby state institutions with water, heat, light and power have reported to the Governor that an adequate plant can be installed at a cost of $105,346. It is said that this will effect a saving to the State of $16,000 a year. S.

NORFOLK, NEB.—The Norfolk Electric Light and Power Company has contracted with the Sugar City Cereal Mills for all of that company's power not used in the milling business, and thus a continuous service for the future is assured. The mill power will be used from midnight till morning and as an auxiliary in case of emergency. The Electric Light Company will also install another steam plant as an auxiliary in case of emergency.

OAKLAND, CAL.—John A. Britton, of the Pacific Gas & Electric Company, announces that his company is about to take over the Suburban Light & Power Company, whose holdings are estimated to be worth $1,000,000. The Suburban Light & Power Company supplies power and light to Haywards, San Leandro, Niles, Irvington, Newark, Elmhurst, San Lorenzo, Pleasanton and other Alameda County towns. Mr. Britton expects the deal to be consummated by the first of the year. A.

WILLOWS, CAL.—A new electric company, which is being formed with C. R. Wickes as one of the prime movers and a number of local people as stockholders, has applied for a franchise for a line through the streets of Willows. The company expects to get power from the Sacramento Valley Power Company, the latter's line now being three miles from Orland. If the local company secures the franchise its representatives promise to furnish the citizens of Willows with light and power within six months.

ATLANTA, GA.—The Atlanta movement for more general use of electricity in illuminating the business streets of the city is steadily gaining momentum, and three more streets have recently been placed in the list. The finance committee has adopted a further resolution favoring an appropriation for extending the "white way" to include Marietta, Forsyth and Broad Streets, and a further resolution urges the finance committee of 1911 to set aside the needed money for the similar illumination of Peachtree, Whitehall, Hitchell, and the three first named streets during the coming year. Special ornamental lights are in use for the purpose and the movement is one of the most popular of recent years with the business men and the city generally. L.

ELECTRIC RAILWAYS.

(Special Correspondence.)

TEXARKANA, TEX.—The Texarkana Gas & Electric Company will extend about two miles of double track on Broad Street. K.

LOS ANGELES, CAL.—The Southern Pacific Railroad Company is reported to be arranging to electrify its 170 miles of track between Los Angeles and Bakersfield. A.

MARTINEZ, CAL.—The first rail of the Oakland-Antioch Railroad has been laid at Bay Point. A. W. Maltby, who is financing the project, expects the road to be completed and ready for operation within six months. A.

DEFIANCE, OHIO.—The Defiance Interurban Railway Company was incorporated a short time ago at Columbus, Ohio, and expects to build a trolley line from that city to Ft. Wayne, Ind. The line is being surveyed. H.

WARSAW, IND.—The officials of the Winona Interurban Traction Company are working on a plan of operating sleeping cars over electric lines between Michigan City and Indianapolis and possibly Lousville, Ky. S.

SAN FRANCISCO, CAL.—The Owens River Electric Railway Company has been incorporated by C. Hillyer, E. A. O'Brien, M. R. Jones, G. Carter, R. C. Pardoe, T. W. Forsyth and D. D. Oliphant, with a capital stock of $200,000.

SAN RAFAEL, CAL.—Geo. D. Shearer has been granted a street railway franchise covering the principal streets in this city and stipulating that the work shall commence within three months and be completed within two years. A.

KANKAKEE, ILL.—Two-thirds of the right-of-way between Urbana and Kankakee has been secured by the Kankakee & Urbana Electric Railway Company. A meeting of stockholders and directors will be held December 12 at Kankakee. Z.

ELKHART, IND.—A subsidy tax made of the construction of the Kalamazoo, Elkhart and South Bend Traction Company has been voted by the citizens of Washington township, Elkhart County. Work on the new line is to begin soon. S.

INDIANAPOLIS, IND.—The Indiana Railroad Commission is greatly interested in the success of the automatic track-circuit block signal protection the managers of the Terre Haute, Indianapolic & Eastern Traction Company are about to install. S.

SAPULPA, OKLA.—The Union Traction Company has let the contract to the Interurban Construction Company of Muncie, Ind., for the construction of an interurban line to Tulsa, which will be completed by June, 1911. The cost will be about $300,000. K.

McALESTER, OKLA.—L. E. Fischer of Danville, Ill., has accepted a position with the McAlester Interurban Company as General Manager. Extensions of this road are being considered that will extend the line to Willerton, Okla., and Denison, Tex.

ATHENS, GA.—The Athens Railway and Electric Company is now engaged in constructing a new concrete car barn, and is rebuilding and improving its lines in various portions of the city. The local system is said to be one of the best equipped in the state. L.

BUTLER, MO.—The Butler Commercial Club is anxious to secure an electric railway and the president has appointed a committee consisting of S. W. Dooley, A. H. Culver, C. H. Burgess, Clyde McFarland and D. K. Walker to aid promoters in raising a fund of $25,000. Z.

CANTON, ILL.—Extension of the line of the Illinois Central Electric Railway Company through the mining camps near Norris and to Farmington is expected to be made next spring. A new 325-kilowatt generator has been installed at the power house in this city. Z.

SALEM, ORE.—The Santium Development Company has asked for a franchise over certain streets in this city for the purpose of constructing an electric railway line between this city and Stayton, claiming that the line will be in operation within two years after the granting of the franchise. A.

MUSKOGEE, OKLA.—The Muskogee Electric Traction Company is considering the building of an interurban line from here to Fort Smith, Arkansas, also a line to Oklahoma City, via McAlester, Holdenville and Shawnee. Philipp D. Miller, of New York, is interested in the transaction. K.

URBANA, ILL.—The Champaign and Decatur and the Decatur and Bloomington interurban lines have been merged into the Bloomington, Decatur & Champaign System. The articles of incorporation were filed with the Recorder in this city December 1. The headquarters of the company will be in Champaign. S.

SOUTH BEND, IND.—All electric cars operating in this city or operating in and out of this city will be required to equip their cars with safety fenders according to an ordinance recently passed. This action is due to the killing of a child by an interurban express car. The penalty for non-compliance with the ordinance is $5 to $200 a day. S.

CHAMPAIGN, ILL.—The three-years contract between the Illinois Traction System and the interurban car men was put into effect December 1, granting an increase in their wages of ten per cent and making an additional ten per cent advance after six months certain to those who remain in the service. The system employs nearly 500 men. S.

SPRINGFIELD, ILL.—Articles of incorporation have been filed by the Elgin Belt Railway Company with a capital stock of $25,000, formed to construct a railway from Batavia to Des Plaines. The incorporators who compose the first board of directors are Phillip Freiler, Joseph Newman, M. C. Eppenstein, J. M. Blackburn and C. F. Terhume, all of Elgin. Z.

EVANSVILLE, IND.—At a meeting held in this city November 22 by Charles Murdock, Henry W. Marshall and W. T. Durbin, all connected with the Evansville and Southern Indiana Traction Company, a plan was formulated to build a connecting link between Sullivan and Pataka at once. When completed, Indianapolis and Evansville will be connected by trolley. S.

RICHMOND, IND.—At a call by the Richmond Commercial club a meeting was held in this city December 2 by representatives from Portland, Brookville and Harrison, O., and steps taken to build an interurban road from Portland to Harrison by way of Richmond and Brookville. When completed the road will afford trolley traffic from Ft. Wayne to Cincinnati. S.

BELLINGHAM, WASH.—A $2,000,000 bond issue is back of the Nooksack Valley Traction Company which plans to build a sixty-mile road in Whatcom County. The bonds will pay six per cent interest and run for thirty years. Vice-president Morrison states that the first piece of road to be built will be between the Guide Meridian road or Meridian Street and at the Junction of the Marietta road with the Great Northern.

ALBANY, N. Y.—The International Traction Railways of Buffalo has been incorporated with a capital of $100,000, to operate a railroad in the Abbott Road, Buffalo, between Cazenovia Street and the southerly line of Buffalo. The directors include Morris Cohn, Jr., Niagara Falls; Robert L. Fryer, O. P. Letchworth, Buffalo; Thomas E. Mitten, Chicago; Edmund B. Osier, Toronto, and Nelson Robinson, New York.

SPRINGFIELD, ILL.—Power for the Springfield-Jacksonville Interurban Railway will be supplied, it is said, by the McKinley lines which operate the street lines in Jacksonville. It is ultimately planned to extend the line from Jacksonville to Quincy, when a power house will be built upon the banks of the Illinois River, a dearth of water making Jacksonville an inconvenient location. Thirty or thirty-five miles have been graded. Z.

ATLANTA, GA.—The Board of Trade of Stone Mountain, a small town sixteen miles from Atlanta, is preparing to lay before the Georgia Railway and Electric Company a proposition looking to the extension of the electric line through Decatur to that place. It is understood that the electric company has already surveyed a route from Decatur to Stone Mountain, and residents of the latter place believe that within a short time they will have a trolley line connecting them with Atlanta. I.

SOUTH BEND, IND.—The Porter, Chesterton and South Shore Railway Company has filed articles of incorporation with the secretary of state. Capitalized at $40,000. The declared purpose of the corporation is to operate an interurban electric and street railway within the limits of the towns of Porter and Chesterton, and from thence westerly to a junction within the main line of the Chicago, Lake Shore and South Bend Railway Company at and near Baileytown, in Porter County, for the conveyance of passengers and freight and also for the distribution of current for light and power. Directors are C. N. Wilcoxon, F. J. Lewis Meyer, C. E. Palmer, F. M. Childs and J. M. Childs. S.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

SLOAN, IOWA.—A franchise has been voted to the Woodbury Telephone Company. C.

EDELSTEIN, ILL.—The Farmers' Telephone Company is building a line into Prairie Township. Z.

MONTEZUMA, IOWA.—The Interior Telephone Company is making important improvements. C.

BRAGGS, OKLA.—The Braggs Telephone Company has been incorporated with a capital stock of $10,000. P.

GRAND ISLAND, NEB.—The Nebraska Telephone Company has commenced work on the erection of a building. C.

ELKADER, IOWA.—The Bordman & Wagner Telephone Company has incorporated with a capital stock of $1,000. C.

PLENTYWOOD, MONT.—The Montana Star Telephone Company will build a local exchange. The Dakota Western Telephone Company is building a line to Bainville. C.

HYDRO, OKLA.—The McCool Telephone Company has been incorporated with a capital of $500. The incorporators are: F. M. Saunders, E. C. Cole and F. R. Arnold. K.

SULLIVAN, ILL.—The Sullivan Home Telephone Company has been incorporated with a capital stock of $70,000 to conduct a general commercial telephone business. The incorporators are C. B. Cheadle, A. G. Hawley and R. R. Sterrett. Z.

SPOKANE, WASH.—The Washington Consolidated Telegraph & Telephone Company, capital $1,000,000, has been incorporated by C. M. Cooley, of Spokane, and others, to take over a number of the smaller and independent telephone systems in this vicinity.

BLANDINSVILLE, ILL.—The Blandinsville Telephone Company, of which E. E. Fletcher is general manager, is building a new home for the local exchange which will be fitted with new equipment. A metallic-circuit system will be installed both in the city and surrounding country. Z.

FOREMAN, ARK.—The business men of Foreman have organized a telephone company, with a capital stock of $5,000. Following are the officers of the company: A. Goldsmith, president; John H. Hawkins, secretary and treasurer; A. J. Kizer, general manager; A. B. Killian, local manager.

MUNCIE, IND.—The Delaware & Madison Counties Telephone Company have begun the expenditure of $25,000 or more on the improvement of its property in Muncie and the toll lines running out of the city. New toll lines will be built this winter to Newcastle, Gaston and Alexandria.

COLETA, ILL.—Farmers in the vicinity of Coleta have formed a company which will build a telephone exchange. J. L. Deets was elected president and Dr. William Patch, secretary. Plans call for placing of stock at $30 a share in adjoining townships. An effort will be made to connect with Sterling. Z.

DES MOINES, IOWA.—The final step in the consolidation of the two telephone systems of Des Moines and the completion of the Drake Park switch board will be made before January 1. This will include the cutting of all the lines, both Mutual and Iowa, which now enter the Iowa exchange on the east side.

MARSHALLTOWN, IOWA.—At a meeting of the directors of the Farmers' Telephone Company it was decided to install an automatic exchange in this city. A committee composed of F. M. Wheeler, Chas. R. Lynch, F. E. DeWitt and N. D. Smith was appointed to investigate the advisability of taking this step.

MOUNT STERLING, ILL.—The stock of the Mount Sterling Telephone Company has been sold to the People's Telephone, Electric Light and Power Company for $12,000. Possession is to be given January 1, 1911. Senator W. I. Manny has been the principal promoter of the new company. The present system is to be extended and otherwise improved.

COLUMBUS, O.—At a recent meeting held in this city a plan was formulated looking to the consolidation of the Bell Telephone Company interests and the remaining independent interests of Ohio, Indiana, Michigan and portions of New York. It is proposed to organize a new $50,000,000 corporation to take over all the properties. The first step will be the introduction in the Ohio legislature, which convenes in January, of a public utilities bill that will enable the telephone companies in the state to merge and will give the State Railroad Commission power to regulate rates. It will be argued that at present there is at least fifteen per cent duplication of service, which could be avoided by the merging of interests. H.

TOLEDO, O.—As a result of recent telephone mergers in Toledo the City will institute suit in the local courts to take over conduits valued at $75,000. The conduits were originally constructed by the Harrison Telephone Company under a franchise granted in May, 1894. The Company operated an independent telephone system and agreed that it would not combine with any other company and that if it did all its equipment should become the property of the City. The property is now held by the Bell Telephone Company and is considered worth a rental of $5,000 per year, as it traverses the main streets of Toledo. An ordinance has been approved repealing the grant made to the Harrison Company, on the ground that it is no longer in operation. H.

ELECTRICAL SECURITIES.

Several events among which was the pessimistic speech of James J. Hill, tended to produce a general lowering of prices, so that quotations dropped from two to five points below the values established last week. As the prices declined there was liquidation, particularly so, it is reported, by large interests which had overbought on the October rise. The fact that Steel, Union Pacific and Reading, together furnished sixty per cent of the week's trading, however, indicates the nature of the leadership in the decline. Steel manufacturers representing ninety-five per cent of the output of the country met here and decided that prices should not be cut. Business at fifty per cent of capacity was generally reported as improving and there were some substantial orders, notably that of the Pennsylvania for 150,000 tons of rails for 1911 delivery.

Officers of the Commonwealth-Edison Company have been re-elected.

The Massachusetts Railroad Commission has approved the sale of 1,049 unsubscribed shares of West End Street Railway stock at public auction.

Gross earnings of the Brooklyn Rapid Transit Company continue to gain over last year's, although less rapidly than was the case until this fall. For recent weeks they have average five per cent larger than in corresponding periods of 1909-10.

At a meeting of the directors of Public Service Corporation of New Jersey, in Newark, Tuesday, Horatio G. Lloyd and J. Horace Harding were elected to the board, to fill vacancies. Mr. Lloyd is a member of the firm of Drexel & Company, of Philadelphia, and Mr. Harding is of the firm of Charles D. Barney & Company, of New York. Edgar B. Ward had previously been chosen as a director, to succeed the late Dr. Leslie D. Ward.

DIVIDENDS.

Buffalo General Electric Company; common dividend of one and one-half per cent, payable December 30.

Duluth-Superior Traction Company; common quarterly dividend of one and one-quarter per cent; and preferred quarterly dividend of one per cent, both payable January 3.

Indianapolis Street Railway Company; three per cent, payable on January 1 to holders of record December 22.

Interborough Rapid Transit; regular quarterly two and one-quarter per cent, payable January 3 to stock of record December 24.

Massachusetts Electric Company; regular semiannual dividend of two per cent, payable January 2 to stock of record December 15.

Muskogee Gas and Electric Company; preferred quarterly dividend of one and three-quarters per cent, payable December 15.

Northern Ohio Traction and Light Company; regular quarterly three-fourth of one per cent, payable december 15 to stock of record November 30.

Oklahoma Gas and Electric Company; common quarterly dividend of two per cent, payable December 15.

San Diego Consolidated Gas and Electric Company; common quarterly dividend of one and three-fourths per cent, payable December 15.

South Jersey Gas, Electric and Traction Company; regular semiannual dividend of four per cent, payable from rentals received from Public Service Corporation of New Jersey.

Standard Gas and Electric Company; preferred quarter dividend of one and three-fourths per cent, payable December 15.

Twin City Rapid Transit Company; common quarterly dividend of one and one-half per cent, payable January 3; preferred quarterly dividend of one and three-fourths per cent, payable January 3.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Dec. 5.	Nov. 28.
Allis-Chalmers common	8⅛	8¾
Allis-Chalmers preferred	24	33
Amalgamated Copper	64¼	69⅝
American Tel. & Cable	78	*84
American Tel. & Tel.	140	142¾
Brooklyn Rapid Transit	74⅝	77⅝
General Electric	151	160
Interborough-Metropolitan common	18¾	20½
Interborough-Metropolitan preferred	51¾	55½
Kings County Electric	123	123
Mackay Companies (Postal Telegraph and Cables) common	87½	90
Mackay Companies (Postal Telegraph and Cables) preferred	74	74
Manhattan Elevated	137	140
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	42	45
U. S. Steel common	73½	79⅞
U. S. Steel preferred	115¼	118⅛
Western Union	70⅝	72¼
Westinghouse common	65¾	72
Westinghouse preferred	120	122½

*Last price quoted.

BOSTON.

	Dec. 5.	Nov. 28.
American Tel. & Tel.	139½	142
Edison Elec. Illuminating	278	282
General Electric	151	160
Massachusetts Electric common	17⅛	19¾
Massachusetts Electric preferred	85	87
New England Telephone	138¼	137½
Western Tel. & Tel. common	16½	17½
Western Tel. & Tel. preferred	90	91

PHILADELPHIA.

	Dec. 5.	Nov. 28.
American Railways	42¾	43
Electric Company of America	11¾	11⅝
Electric Storage Battery common	47½	49
Electric Storage Battery preferred	47½	49
Philadelphia Electric	15½	15¾
Philadelphia Rapid Transit	17⅞	18¾
Philadelphia Traction	83	83
Union Traction	43½	44

CHICAGO.

	Dec. 5.	Nov. 28.
Chicago Railways, Series 1	92	91
Chicago Railways, Series 2	22¾	25½
Chicago Subway	4	4¾
Chicago Telephone	122½	122
Commonwealth Edison	115	115¾
Metropolitan Elevated common	19	19
Metropolitan Elevated preferred	64	62
National Carbon common	120	120
National Carbon preferred	118½	119

PERSONAL MENTION.

WALTER LYMAN UPSON, formerly at Ohio State University, has been appointed professor of electrical engineering in the University of Vermont.

W. L. KIMBALL has resigned his position as treasurer of the American Transformer Company, of Newark, N. J., which he has held since its organization.

CHESTER W. SMITH, who had charge of the construction of the Roosevelt dam in Arizona has resigned from the Reclamation Service. Mr. Smith will engage in private engineering work.

L. J. OVERBY, of Virden, Ill., has been appointed manager of the Illinois Telephone Company's properties at White Hall, Ill., to succeed E. O. Turner, who takes charge of an exchange at Tarkio, Mo.

W. H. SMAW, formerly assistant to the purchasing agent for the Georgia Railway & Electric Company, was promoted to the position of purchasing agent of that company December 1. Mr. Smaw succeeds George B. Graves, who recently resigned.

DUGALD CRAWFORD HILL has been elected secretary of the Metropolitan Electrical Supply Company, of Chicago, Ill. Mr. Hill is not an electrical man but has had a good business training under the tutelage of Marshall Field & Co., and is well equipped for his new field of endeavor.

J. B. ADAMS, formerly in charge of the Pacific Gas & Electric Company's plant at Colgate, Cal., has been made superintendent of the DeSabla power division and I. B. Adams, whom he succeeds, has resigned to go to South America. The Colgate-Hydroelectric plant is now in charge of Joseph Mini, Jr.

PERRY P. ANDERSON, who has been connected with *The Drygoodsman* at St. Louis, resigned to accept a position as manager of the properties of the Canton Home Telephone Company of Canton, Ill., effective December 10. J. A. Wynes, his predecessor, will take charge of the inspection of inside equipment for the Chicago Telephone Company at Chicago.

J. E. NOEGGERATH has returned recently from an extended trip to Europe, where he has been busy as a consulting engineer to the administration of a number of large European enterprises. Mr. Noeggerath has established his headquarters at 59 Wall Street, New York City. In a note in a recent issue of this journal the address was incorrectly given.

SAMUEL INSULL, president of the Commonwealth Edison Company of Chicago, has been appointed by President William Busse, of the Cook county board, as a member of the Forest Preserve Commission. The new forest preserve district act, under which Mr. Insull was appointed, creates a new tax levying body with power to issue bonds to the extent of one per cent of the taxable property of Cook county, approximately $10,000,000.

LOUIS C. OLESON, for a number of years with the Standard Cedar & Lumber Company, Minneapolis, Minn., announces that he has severed his connection with that company to assume the presidency of the Three States Cedar Company, Palace Building, Minneapolis. Mr. Oleson is well and favorably known in the cedar industry and met with great success while connected with the Standard Company. The Three States Company handles the forest products of Minnesota, Wisconsin and Michigan, but will pay special attention to white cedar poles and posts. Mr. Oleson's many friends predict a successful career for him in his new venture.

LEGAL NOTES.

EXTRA CARE NOT REQUIRED TO GUARD THIRD RAILS FROM TRESPASSING CHILDREN.—Where the track of a railroad operated by the third-rail system was fenced in and a boy between seven and eight years of age, attracted by some flowers on the other side of the rails, opened the gate, and in attempting to cross the track, fell and came into contact with the third rail, whereby he was permanently injured, the United States circuit court of appeals, third circuit, holds that the company was not liable for damages. It does not consider that the company owed a duty to the boy to use such care in guarding and protecting the third rail as would have prevented the injury which happened to him. There was nothing wilfully injurious in the company's installing upon its own premises the third rail, dangerous though it was to those who came into contact with it, for the lawful purpose of operating an electric railway system.

DEFECTIVELY INSULATED WIRE ON MOTOR CAR.—An electric wire, used on a motor car to carry the electric current from the overhead trolley wire to the machinery of the motor car, on which the insulation is allowed to become so broken, or defective, as to permit the naked wire to come into contact, either with the metal top of the circuit breaker, or with the body of an employe, whose duties are such as to require him to work on, and about, such motor car, is not a reasonably safe appliance.—Supreme Court of Appeals of West Virginia in Mitchell vs. United States Coal & Coke Company, 68 S. E., 366.

DELAY IN FURNISHING TELEPHONE CONNECTION.—An Iowa statute makes the proprietor of a telegraph or telephone line liable, among other things, for any unreasonable delay in the transmission or delivery of messages. The Supreme Court of Iowa says that the delay in the transmission or delivery contemplated by the statute, with reference to a telephone company, is that of not furnishing the proper connection within a reasonable time as well as in otherwise transmitting messages so that upon a showing of an unreasonable delay by a plaintiff it devolves upon the defendant telephone company to establish by a preponderance of the evidence that such delay was not due to negligence on its part. Volquardsen vs. Iowa Telephone Company, 126 N. W. 928.

AN INTERESTING VACUUM SWEEPER DECISION.—The St. Paul, Minn., *Pioneer Press*, of November 22, states that Judge Willard, in the United States District Court, on November 21, heard arguments upon the order to show cause why B. B. Downs and the B. B. Downs Company, of St. Paul, should not be held in contempt of an order issued last July by Judge Amidon, restraining the Downs Company from manufacturing a vacuum cleaner known as the Downs Suction Sweeper No. 1. The order was procured by the McCrum-Howell Company, and it was alleged that the Downs sweeper was so similar to the Richmond as to be an infringement of its rights, and its manufacture constituted unfair trade competition. Judge Willard held that the order to show cause should be discharged, and that the Downs Company was not in contempt of court in manufacturing their present sweeper.

DUTY TO SELECT AND USE THE BEST METHODS KNOWN TO SCIENCE.—The Court of Civil Appeals of Texas holds that there was no error in refusing to instruct a jury that if a person was injured by a stroke of lightning conducted into the house over telephone wires, still they should not return a verdict against the company for damages if they believed that such wires were grounded by wrapping the line wire with the ground wire and that that was as good protection as known to the company's agents and employes. The court considers that the duty devolving upon the company was not only to use as good precaution as known to it or its agents, but the further duty was imposed of at least exercising such reasonable precaution as a man of ordinary care and prudence would do to select and use the best methods known to science for the prevention of such injuries; and, since it was operating a dangerous agency, it could not escape liability alone on the plea that the instrumentalities used for the protection of its patrons were as good as known to it. If there were better methods of protection known to science it should be held at least to the exercise of ordianry care to select and use them.—Texas Telegraph & Telephone Co. vs. Scott, 127 S. W. 587.

HIGHER RATES FOR NEW SUBSCRIBERS THAN OLD.—A telephone company fixed higher rates for all new subscribers after a certain date. It was sought to justify this by showing the amount invested in the exchange, the increase in telephones, the increased expense of operating the greater number of telephones, and the profits on the investment for the different years, it being argued that the business could not live at the rate charged, and that the loss was occasioned by the investment for new subscribers and the increased expense of operating the exchange which they caused. The company therefore claimed that it was just and reasonable that new subscribers should be charged more than old subscribers, and that the new subscribers were in a class by themselves. The Supreme Court of Michigan, however, holds that the company was guilty of discrimination against a would-be new subscriber, in violation of the letter and spirit of section 5270 of the compiled laws of Michigan, prohibiting discrimination by telephone companies, which it says is but declaratory of the common law. While it is probably true that the cost of operating a telephone exchange increases with the increased volume of business, it is equally true that the whole body of subscribers, whether new or old, makes the added expense, and reaps the added benefit. A telephone exchange with 1,000 members is manifestly more valuable to every subscriber than one with 100 members, but it is equally valuable to each member in the same class, and its value to the subscriber does not depend, in any degree, upon whether he is a new subscriber or an old one. —Bradford vs. Citizens' Telephone Co., 126 N. W. 444.

DOCTRINE OF FELLOW SERVANTS LIMITED FOR ELECTRICAL INDUSTRY.—A lineman with his helper went to substation and requested that certain feed wire be killed while they performed certain work. It had been disconnected for another employee, and when later notice was given by the latter that the current could be put on again it was done, resulting in the death of the helper mentioned. The Supreme Court of Wisconsin holds, in the resulting suit for damages, that a distinct and independent employee to whom is delegated the duty to disconnect and make safe the wires on which others must work is ordinarily a vice principal, and not a fellow servant, with the lineman and other like workmen. Whether the operator in this case was such was at least susceptible of affirmative answer by the jury, as also whether the place or appliances furnished the helper were rendered not reasonably safe by failure of the master's duty intrusted to such operator. Wherefore it was error to enter judgment of nonsuit. We now confront an industry relatively new, at least in present development, the court says, where employees must work in places which are rendered unsafe by other agents or employees hired to do the determining act for the purpose of creating the safety—employees with whom the exposed workmen have no contact or community save that both are employed to carry on the general business of generating and distributing the master's merchandise, as are traveling salesmen. Reasons which may have led to classing as fellow servants men employed in conduct of railroads may fail to control situations in this field, though apparently closely analogous. One distinction is in the sudden and unavoidable nature of the peril from a failure to take proper and easy precautions, as in this case. A man at one moment is handling a cold and harmless wire which it is the duty of his master to keep so. The next he is in contact with a deadly peril, unforseeable and unescapable, by reason of the act of another whom his master has employed to perform the duty resting on the latter to make and keep safe the place of work. The court thinks reasons to hold that the persons so employed are agents performing a nondelegable duty are very apparent.—Massy vs. Milwaukee Electric Railway and Light Company, 126 N. W. 544.

NEW PUBLICATIONS.

THE NATIONAL CLEANER AND DYER has appeared as a successor to the Cleaners and Dyers department of the *National Laundry Journal*. It is published by Dowst Brothers Company, Chicago.

NEW GEOLOGICAL SURVEY REPORTS.—The United States Geological Survey has just published a report on the geology and water resources of the San Luis Valley, in south-central Colorado, by C. E. Siebenthal, geologist. A report has also been published on the water powers of the Cascade Range, in southern Washington.

BULLETIN OF THE NATIONAL ELECTRIC LAMP ASSOCIATION.—The November bulletin of the National Electric Lamp Association contains an excellent description of the engineering and scientific activities of the National Electric Lamp Association. Illustrations are shown not only of the extension of the buildings, but of the various laboratories and offices. Each phase of the work in the various departments is treated separately so that the reader may gain an excellent idea of the research work which is being carried on.

GEORGE WESTINGHOUSE AND HIS NEW INVENTIONS.—A reprint from the *New York Tribune* gives an account of the inventions of George Westinghouse and the work which he is now carrying on. Especial attention is called to the new shockless automobile spring. This invention will, in a measure, take the place of pneumatic tires with a saving of discomfort and inconvenience which will be much appreciated by the automobile owner. A full page illustration of the air spring attached to an automobile is included in the publication.

THE UNIVERSAL TECHNICAL REGISTER.—A new publication is to be started in January, 1911, by Boll & Pickardt, Berlin, Germany, entitled "Technische Welt-Register." This journal will comprise a review of the technical literature of the world, and will be divided into three parts. The first part will give a list of journals and the articles appearing in them arranged by countries. The second part will have the same material arranged alphabetically by subjects, while the third part will contain short abstracts of certain articles of special importance. The yearly subscription will be twenty-four marks, ($5.72).

THE EFFECT OF KEYWAYS ON THE STRENGTH OF SHAFTS.—Under this title has been issued Bulletin No. 42 of the engineering experiment station of the University of Illinois. This bulletin gives the results of tests to determine the relative strength of solid shafts and of shafts with keyways. A table showing power transmission by cold-rolled shafting with keyways and a diagram illustrating the weakening effect of keyways are given. Copies of the Bulletin No. 42 may be obtained gratis upon application to W. F. M. Goss, Director of the Engineering Experiment Station University of Illinois, Urbana, Illinois.

HIGH EFFICIENCY LAMPS.—Under this title is published by the engineering department of the National Electric Lamp Association, a paper on the effect of high-efficiency lamps on the cost of light to the central station, which was read before the St. Louis meeting of the National Electric Light Association by S. E. Doane. The paper analyzes the items of expense in connection with the generation of electrical power, and goes into a definition of the terms used. The relative cost of serving various classes of customers is also considered. The bulletin in which this paper

appears also contains a number of editorials from the leading electrical journals commenting on the phases of the subject as treated by Mr. Doane.

WATER SUPPLY PAPER 253.—The United States Geological Survey has just published under this title a report on the water powers of the Cascade Range in southern Washington, by John C. Stevens. The streams considered in this report are Klickitat, White Salmon, Little White Salmon, Lewis, and Toutle Rivers and other streams in the drainage basins of these rivers. The entire system of streams surveyed will afford about 395,000 horsepower. The total water power available in the Columbia River basin has been estimated at 10,500,000 horsepower, so that the region covered by the report will furnish only four per cent of the enormous aggregate, yet even this small percentage is five times the amount of water power already developed in the state. The report contains descriptions of the rivers named and of their important tributaries, with tables showing stream discharge, location of water-power sites and the amount of power available at each site, a summary of the water laws of Washington, tables showing annual mean and minimum discharge of representative streams of the northwest Pacific Coast, and rainfall tables for numerous places in Washington and Oregon. The most valuable part of the report is a series of plans and profiles showing the course and gradient of each stream surveyed. The report may be obtained without cost by applying to the Director of the United States Geological Survey at Washington.

NORTH DAKOTA LIGNITE AS A FUEL FOR POWER-PLANT BOILERS is the title of Bulletin No. 2 recently issued by the Bureau of Mines. This bulletin describes a series of tests at the pumping plant of the United States Reclamation Service at Williston, N. D. The Reclamation Service has a large project there and had installed steam boilers with furnaces designed to burn a "brown lignite" that was mined on adjacent government land. The furnace is of the semi-gas-producer type and has an external resemblance to the so-called Dutch oven. The most striking features in its construction are the deep-set grate and the construction of the space between the bridge wall and the end of the prolonged fire-brick arch. The furnace is designed to work on the gas-producer principle. The solid fuel is gasified on the grate and the gas passes through the space under the arch into the combustion chamber where most of the gaseous combustible burns. The results of the tests on the lignite show that this fuel, though generally considered unsatisfactory, may be used with fair economy under boilers that generate their full rated capacity. In fact, when the number of heat units available is considered, the results compare favorably with those of better grades of fuel. The lignite in this field is low in heating value, some of it containing nearly forty-five per cent of its weight in moisture, and it is difficult to burn in the furnaces commonly used for the better grades of coal, but the tests have shown the possibility of designing suitable furnaces for burning it profitably.

PROPOSALS.

LIGHTING FIXTURES.—Sealed proposals for the lighting fixtures to be installed in the Kankakee County Court House, Kankakee, Ill., will be received until December 21. Plans are in the hands of Architect Zachary T. Davis, suite 1009-11 Steinway Hall Building, No. 17 East Van Buren Street, Chicago. Z.

POST OFFICE, WAYCROSS, GA.—The Office of the Supervising Architect, Washington, D. C., will receive sealed bids until January 7, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States post office at Waycross, Ga., in accordance with drawings and specification, copies of which may be had from the custodian of site at Waycross, Ga., or at the Supervising Architect's office.

POST OFFICE, MISSOULA, MONT.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until December 27 for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States post office at Missoula, Mont., in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Missoula, Mont., or at the Supervising Architect's office.

NEW INCORPORATIONS.

CHICAGO, ILL.—The National Electric Controller Company has been incorporated with a capital of $5,000 by J. F. Erne, E. H. Sullivan and G. S. Erne.

CHICAGO, ILL.—The Buchanan Electric Steel Company has been incorporated with a capital stock of $6,000 to manufacture and deal in steel and iron products. Z.

JASPER, TEX.—The Jasper Electric Company has been incorporated with a capital of $5,000. The incorporators are H. C. Howell, J. H. Seale and O. M. Stone.

CLOQUET, MINN.—The Brush Electric Company has been incorporated with a capital of $10,000. The incorporators are O. F. North, H. G. Stephen and J. F. Owens.

SAN FRANCISCO, CAL.—The Sanitary Telephone Mouthguard Company has been incorporated by G. A. Moore, J. L. Gould, J. L. Miller, G. H. Baudry, F. A. Brown, E. R. Blake, R. P. Rogers, J. W. Scott and F. R. Grother with a capital stock of $300,000.

CHICAGO, ILL.—The Buckmann Electric Steel Company has been incorporated with a capital stock of $6,000 to produce steel and iron forgings. The incorporators are H. J. Allen, John C. Meechen, Norris M. Orill, C. P. Schwartz and K. K. Knapp.

OMAHA, NEB.—The Murphy Did It Company has been organized with a capital of $10,000 to manufacture a patent trolley retriever. The officers are: Nels Peterson, president; Andrew Murphy, vice-president; Bert Murphy, treasurer, and W. A. Schall, secretary.

DOVER, DEL.—Articles of incorporation have been filed for the King Phone Distributing Company of Pittsburg, Pa., to deal in telephones. The incorporators are Raymond M. Kaufman, Karl J. Kaufman, Chester Kaufman, all of Pittsburg. The capital stock is $2,000.

INDUSTRIAL ITEMS.

THE FOSTORIA GLASS SPECIALTY COMPANY, Fostoria, O., has distributed to the trade attractive advertising calendars for the month of December.

THE ELMER P. MORRIS COMPANY, 86 West Street, New York City, is supplying its lamp-post design No. 40,000 for the lighting of the main streets of Elmira, N. Y.

THE NOVELTY INCANDESCENT LAMP COMPANY announces the removal of its general offices from Emporium, Pa., to 1733 Broadway, New York. This change in address took place on December 1.

THE SHELBY ELECTRIC COMPANY, of Shelby, O., manufacturers of all types of incandescent electric lamps, have just opened a branch office at room No. 1102 Chandler Bldg., Atlanta, Ga. This office will be in charge of H. G. Scott.

THE ROME WIRE COMPANY, Rome, N. Y., is sending out post-card calendars for the present month. The card advertises the Company's bare and tinned copper wire, magnet wire, annunciator wire and rubber-covered code and telephone wires.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has issued a catalog of holiday suggestions for the purpose of giving its customers a general idea of its holiday line of goods. A large number of mechanical and electrical toys, Christmas tree miniature lamps and goods suitable for Christmas gifts are listed.

THE MASSACHUSETTS CHEMICAL COMPANY, manufacturers of liquid electrical insulation, tapes and splicing compounds, is moving into the extensive additions to its plant at Walpole, Mass., which comprise a new four-story manufacturing building, a four story reclaiming building and a new power plant, together aggregating about three acres of floor space.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY publishes in its recently issued "Ad Book No. 22" a series of attractive advertisements suited to the use of central-station companies that are anxious to boom their Christmas trade in electrical appliances. Each advertisement in the book contains a reflection of the spirit of the Christmas season.

THE SCHUG ELECTRIC MANUFACTURING COMPANY, Detroit, Mich., describes in a recent catalog, its isolated electric lighting plants. The outfit consists of a generator run by gasoline or other means, storage batteries and a switchboard with necessary accessories. Plants are furnished in various sizes and styles to meet the requirements of several classes of service.

THE GARVIN MACHINE COMPANY, New York, N. Y., has recently issued circulars No. 152 and No. 135. The former describes the Garvin No. 2 hole-grinding machine, and the latter, the Garvin universal milling machine No. 2A. Both publications are illustrated with half-tone engravings and each contains a number of drawings showing the construction of the machines in detail.

H. W. JOHNS-MANVILLE COMPANY, New York, N. Y., announces that owing to increased business its offices now located at 85 Sheiden Street, Houghton, Mich., will be moved to more commodious and convenient quarters at 96 Sheiden Street. S. T. Harris, who has been associated with the Company for a number of years, will be in charge of the offices at the new address.

THE ELECTRIC SPECIALTY MANUFACTURING COMPANY, of Cedar Rapids, Iowa, has purchased the patent rights for a device for locating trouble in electric circuits, consisting of a vibrator for producing a current in the faulty circuit, an exploring coil and a telephone receiver. They have made several improvements in this apparatus and are adding a feature which permits similar testing in armatures.

THE VULCANITE PORTLAND CEMENT COMPANY, Philadelphia, Pa., calls attention in a recent folder to its impervious concrete and shows an illustration of a concrete water tower made of Vulcanite Portland cement without the use of any waterproofing material. A pamphlet on "Selection and Proportion of Aggregates," which was recently published by this company will be furnished to those interested.

THE MINNEAPOLIS ELECTRIC & CONSTRUCTION COMPANY, Minneapolis, Minn., recently shipped twelve of its wire meters to Japan. These were exported through the Western Electric Company. A number of its meters have also been shipped to

South America. The Minneapolis Company recently secured the contract for rewiring the Minnesota State Hospital at Rochester, Minn., one of the largest contracts of its kind ever placed in Minnesota.

THE CROUSE-HINDS COMPANY, Syracuse, N. Y., has distributed among the electrical trade a handsome booklet, which will, no doubt, act as an inspiration to the dealers handling the company's products. The booklet, which lists and catalogs panel boards and cabinets, is 9 by 12 inches in size, is printed on a good grade of paper and is well illustrated. Details of construction are described, and listings and prices of individual and assembled parts are presented with an unusual clearness.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., has recently booked several large orders for small power motors. These include 1,000 graphophone motors for the American Graphophone Company, 500 one-quarter-horsepower special alternating-current motors for the Electric Renovator Manufacturing Company, 500 one-eighth-horsepower, 110-volt, sixty-cycle motors for the 1900 Washer Company, and also orders for the Wayne Manufacturing Company and the Hobart Electric Company of Troy, O.

THE CONNECTICUT TELEPHONE AND ELECTRIC COMPANY, of Meriden, Conn., is now distributing a new 1911 catalog covering the well-known automobile and motor-boat ignition specialties. This catalog describes the new Connecticut magneto in detail, giving a clear and concise description of the various systems for which this is made. Other new types for 1911 which are illustrated are: the new Connecticut shock absorbers, hinged-bracket spark coils, magneto lock switch, new-type steering wheel switch, new 1911 socket meters and Connecticut auto lock.

THE INSTITUTE OF INDUSTRIAL RESEARCH, 804 Hibbs Building, Washington, D. C., has been established with the object of carrying out investigations of industrial problems along all lines including more especially metallurgical, electrochemical and agricultural problems. The principal object in view is the establishment of an authoritative institute wherein technical and scientific investigations of problems can be carried on in a manner that will insure the highest order of technical research. The director of the new institute is Allerton S. Cushman, formerly connected with the Department of Agriculture. The division of electrical engineering and electrochemistry will be in charge of N. Monroe Hopkins. Land has been acquired near the White House, fronting upon Potomac River Park, where laboratories will be immediately erected.

THE FLOUR CITY ORNAMENTAL IRON WORKS, Minneapolis, Minn., is meeting with exceptional success in placing its Corinthian posts, used in street lighting. The Company recently received an order from the Toronto Hydroelectric System (Municipal plant) for 300 street lighting standards of special design. These posts are for five-light clusters. The same System also ordered 5,000 lanterns to be attached to feed wire poles, each lantern containing a 100-watt tungsten lamp. The Flour City Company's posts are used in various parts of the country, including Atlanta, Ga., Minneapolis, Minn., Rockford, Ill., and Milwaukee, Wis. A short time ago 223 additional Corinthian standards were shipped to Atlanta. In addition to its present installation 200 posts have been ordered for the city of Minneapolis, and Milwaukee has also ordered additional posts.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has just issued a booklet describing miniature decorative incandescent lamps. The lamps are illustrated in color, and various designs representing fruits and flowers are shown. These lamps are used for decorating Christmas trees and also in connection with set pieces of artificial shrubs, trees, etc. The number of the booklet is B-3004. The Company has also isued Bulletin No. 4602-B on the subject of automatic voltage regulators for direct-current generators. Bulletin No. 4782 entitled "Direct Current Exciter Panels" illustrates and describes exciter panels for use in connection with alterating current generator panels when for any reason separate control of the exciter is desired. The bulletin contains a complete description of these panels, also diagram of connections and dimensions. Bulletin No. 4786, entitled "Signals, Auxiliary Apparatus and Materials," cannot fail to be of interest as well as assistance to all railway men. The signal described is a simple and reliable motor signal having a signal mechanism suitable for either two or three position operation in either the upper or the lower quadrant. This standard mechanism is also applicant to either top or bottom mast operation with but slight modifications. The bulletin contains nearly ninety pages of information including exterior and interior views of the signal and a detailed description of the signal and apparatus used in connection with its operation.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has just issued Bulletin No. 1116, describing magneto telephone sets and accessories. This bulletin has been compiled for the purpose of bringing to the attention of telephone companies and telephone users in general the features of Western Electric standard magneto wall and desk sets, together with accessories. The bulletin contains forty pages and is profusely illustrated with photographs. Several pages are devoted to the design and construction of wall and desk sets, and the No. 1317 type wall set is described with attention to the smallest details. A double-page cut shows the characteristic features of this telephone. The bulletin describes and lists backboards, batteries, battery boxes and gauges, binding posts, buzzers, condensers, cords, desk set boxes, desk stands, flexiphones and flexiphone arms, generators and generator boxes, gongs and gong mountings, hand sets, induction coils, and other telephone parts and accessories.

DATES AHEAD.

Electrical Contractors' Association of New York State. Annual meeting, Albany, N. Y., January 16.

Chicago Electric Show. Coliseum, Chicago, Ill., January 7-21.

Minneapolis Electric Show. Minneapolis, Minn., January 26-February 4.

Iowa Electrical Association. Annual meeting, Davenport, Iowa, April 19, 20 and 21.

Directory of Electrical and Allied Engineering and Scientific Societies

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RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) November 29, 1910.

976,836. ELECTRIC ANNUNCIATING APPARATUS. Henry Jacob Alther, Boston, Mass., assignor of one-half to George W. Gill, Medford, Mass. Filed Mar. 18. An annunciator to indicate whether a room is occupied or unoccupied has circuits connected from a central point to each door so that the turning of the lock makes and breaks a circuit and operates the annunciator.

976,838. CIRCUIT-OPENER. Charles C. Badeau, Swissvale, Pa., assignor to Switchboard Equipment Company, Pittsburg, Pa. Filed April 27, 1905. A circuit-breaker with laminated contacts has a portion of its conducting element in the form of an electromagnet. Movement of the pivoted armature under abnormal conditions opens the circuit-breaker.

976,859. TROLLEY GUARD. Michael Eisele, West Carrollton, Ohio. Filed Nov. 19, 1909. Mounted on the span wire is a guard having downwardly extended flanges arranged to contact with the extended axle of the trolley wheel.

976,878. ELECTRICAL SYSTEM OF DISTRIBUTION. Albert S. Hubbard, Belleville, N. J., assignor to Gould Storage Battery Company. Filed June 19, 1908. A direct-current distributing system contains a storage battery and a booster therefor. The exciter for this booster has two field circuits, one in series with the main line and the other connected to the secondary of a series transformer in the same line so that it is subject to the effect of sudden load variations only.

976,925. AUTOMATIC PRESSURE-CONTROLLING DEVICE FOR BRAKE MECHANISMS. Harold Rowntree, Chicago, Ill., assignor to National Pneumatic Company. Filed Jan. 19, 1910. An air brake for cars has electrical devices for operating the air valves, and means controlled by the speed of the car for governing the circuits of these devices.

976,942. TROLLEY POLE. Charles M. Speck and Clarence F. Earl, Chicago, Ill. Filed Mar. 18, 1909. A current collector resembling a bow trolley is arranged to have vertical coil springs to force the collector against the trolley wire and to form a flexible combination. A trolley wheel that can move sideways on this bow is used in making contact with the wire.

976,944. ELECTRIC HEATING-RECEPTACLE. William Stanley, Great Barrington, Mass., assignor to General Electric Company. Filed May 13, 1909. The process of forming electrically heated utensils consists in casting a flat heating unit in the center of a circular disk of sheet metal and spinning the metal around the unit to form a receptacle.

976,947. RAIL BOND. Charles R. Sturdevant, Worcester, Mass., assignor to American Steel & Wire Company, Pittsburg, Pa. Filed June 25, 1910. The bond consists of a stranded flexible conductor with solid terminals and a coating of solder on the ends of the strands.

976,961. COMBINED TELEPHONE AND SERVICE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company. Filed Jan. 6, 1908. Includes a central source of energy and means for transmitting special service impulses by steady current over the line while preventing operative interference with the telephone service currents thereby.

976,962. WALL SET. Alfred H. Weiss, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company, Chicago, Ill. Filed June 17, 1908. A cover for the wall box is adapted to be opened downwardly, and so as to expose the parts of the mechanism on all sides. A hook prevents the cover from striking the wall when it is open.

976,990. ELECTRODE. John T. Dempsters, Schenectady, N. Y., assignor to General Electric Company. Filed July 20, 1905. Renewed April 6, 1910. Consists of a casing and a filling therefor, the composition of which varies along the length of the electrode and is capable of giving a luminous arc.

977,008. TELEGRAPH SYSTEM. George E. Hines, New York, N. Y., assignor of one-half to William T. Daley, Brooklyn, N. Y. Filed April 13, 1907. Relays having polarized armatures are provided with jockeys for restraining the armatures against movement due to the action of stray currents.

977,022. ELECTRIC ARC LAMP. Willy Legel, Berlin, Germany, assignor to General Electric Company. Filed Feb. 3, 1910. An economizer for flaming-arc lamps has an aperture to permit lateral movement of the electrode and a series of superimposed guide plates for sealing this aperture, each plate being pivoted to the next in series and the upper one being connecetd to the regulating mechanism of the lamp while the bottom one is fixed.

977,046. PIG-HANDLING APPARATUS. James F. Schnabel, Pittsburg, a., assignor to Electric Controller and Manufacturing Company, Cleveland, Ohio. Filed Dec. 30, 1907. A machine for handling and breaking up beds of pig iron has a lifting magnet carried by each of two trolleys.

977,058. ELECTRIC CUT-OUT. Benjamin Walpole, Providence, R. I. Filed March 18, 1909. An inclosed fuse.

977,061. MEANS FOR MEASURING CURRENT IN THREE-PHASE SYSTEMS. Carl Wiler, Chicago, Ill., assignor to General Electric Company. Filed Jan. 7, 1909. Consists of a transformer in two of the mains, a measuring instrument, a pair of switches each consisting of spring members normally in contact to connect the transformers in parallel through the instrument, and a plug for separating the members of each switch.

977,067. CENTRAL-STATION CALL SYSTEM FOR TELEPHONE-LINES. William E. Butler, David City, Neb. Filed Feb. 15, 1909. A ringing system has a rotating pole-changer connected to a direct-current source, and an adjustable choke coil in the circuit for converting the current into alternating current.

977,073. LOCKING MECHANISM FOR CONTROLLER-HANDLES. Archibald S. Cubitt, Schenectady, N. Y., assignor to General Electric Company. Filed Nov. 9, 1905. A pawl is carried by the handle and engages a notched member at predetermined points. A slight backward movement of the controller handle releases the pawl.

977,074. VOLTAGE-REGULATED ELECTRIC-LIGHTING SYSTEM FOR RAILWAY AND OTHER CARRIAGES. James Dalziel, Derby, England. Filed Sept. 27, 1904. An axle-driven generator has an auxiliary exciter connected to its fields so as to either strengthen or weaken the latter and thus maintain constant potential. A storage battery is also included in the system.

977,079. AUTOMATIC PRESSURE-CONTROLLER. Howard Reginald Dunbar, Canton, Mass., assignor to Lamson Consolidated Store Service Company, Newark, N. J. Filed July 1, 1907. A lever connected with the piston rod is arranged to engage a hinged contact arm of a motor-starting rheostat.

977,081. ELECTRIC STREET-INDICATING SIGN. James W. Ellis, Denver, Colo. Filed Sept. 7, 1909. Two long rectangular boxes are secured together at an angle at one end. At the point of intersection an incandescent lamp is mounted so that its rays are reflected from diagonal reflecting surfaces within each box and thereby illuminate the glass front of each box.

977,086. ELECTRICAL ELEMENT. Axel Theodor Konstantin Estelle, Fliseryd, Sweden, assignor to Nya Ackumulator Aktiebolaget Jungner, Fliseryd, Sweden. Filed May 20, 1909. A positive electrode mass for alkaline accumulators consists of a nickel hydrate as active material mixed with a conductive substance consisting of finely granulated natural graphite and finely powdered cadmium oxide.

977,111. MAGNETIC BRAKE DEVICE. Joseph N. Mahoney and Oscar S. McCurdy, Wilkinsburg, Pa., assignors to Westinghouse Air Brake Company, Pittsburg, Pa. Filed April 20, 1908. A magnetic track brake electrically operated means independent of the magnetic attraction ebtween shoe and rail in the act of applying the brakes, for causing the shoe to engage the rail.

977,114. RELAY. Ray H. Hanson, Elyria, Ohio, assignor to Dean Electric Company, Elyria, Ohio. Original application filed May 25, 1904. Divided and this application filed June 6, 1906. A telephone relay has a group of contact springs associated with it.

97,123. PANEL BOARD. Raymond H. Olley, Syracuse, N. Y. Filed July 27, 1908. Consists of sections with longitudinal grooves in the rear and transverse grooves in front. Connections of the busbars and switches are made at the points of intersection of the grooves.

977,125. APPARATUS FOR CONTINUOUS ELECTROLYSIS OF AQUEOUS SOLTIONS. Albert Pietzsch, Triberg, Germany, and Ewald Steinbuch, Monthey, Switzerland, assignors to Society of Chemical Industry, Basle, Switzerland. Filed Nov. 17, 1909. Has two superposed electrodes in different compartments, and means to cause the electrolyte to flow from the upper to the lower electrode. A porous fabric is situated between the two electrodes and a second fabric closes the bottom of the compartment of the upper electrode.

977,140. ELECTRIC SWITCH. Percy L. Sibole, Wilkinsburg, Pa. Filed Sept. 20, 1909. A multiple switch has its various contact members actuated simultaneously by a single controlling mechanism.

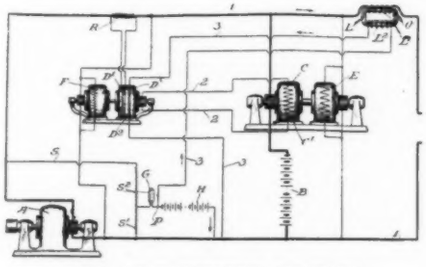
977,142. TELEPHONE SYSTEM. Frank X. Staub, Fort Wayne, Ind., assignor to Corwin Telephone Manufacturing Company, Chicago, Ill. Filed Aug. 8, 1910. Each telephone has a non-inductive shunt connected about the receiver winding and in series with the transmitter.

977,145. PRIMARY-BATTERY PLATE. Alfred O. Tate, Toronto, Ontario, Canada. Filed Feb. 25, 1908. A bifunctional primary battery plate embraces interleaved positive and negative sections separated from each other by porous insulating material.

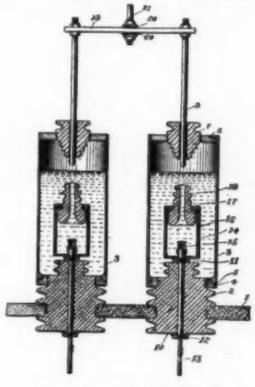
977,156. ELECTRIC TRUCK. Asa F. Batchelder, Schenectady, N. Y., assignor to General Electric Company. Filed April 7, 1906. A truck frame comprises transom and end members rigidly connected together, motor armatures mounted upon the axles between the end members and a U-shaped field magnet supported upon each transom member.

977,158. INCANDESCENT-LAMP MANIPULATOR. Robert H. Berkstresser, York, Pa. Filed June 10, 1909. A device for inserting or removing incandescent lamps from a high chandelier is provided with a container for the lamp, movable fingers carried thereby and a housing sliding in the container and adapted to receive the fingers.

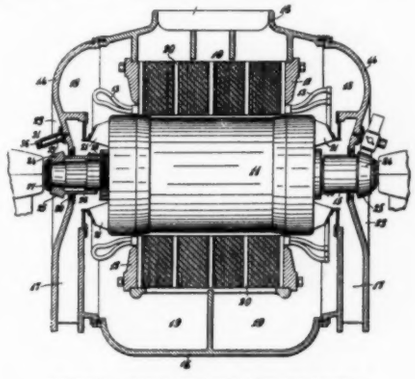
977,187. SWITCH BOX. Gottlieb Gut, Seebach, near Zurich, Switzerland, assignor to Firm of Aufzüge & Räderfabrik Seebach, Switzerland. Filed July 6, 1910. A switch shaft is mounted on the cover of the box, and an auxiliary shaft is mounted in the box wall. When the cover is closed the shafts are coupled together and the cover simultaneously locked.



976,878.—DISTRIBUTING SYSTEM.



977,193.—OIL SWITCH.



977,250.—INCLOSED ALTERNATOR.

977,192. ELECTRIC DROP-CORD ADJUSTER. Warren S. Hull, Sheldon, Ill. Filed Jan. 15, 1910. A casing contains a spool for winding up the cord.

977,193. OIL BREAK SWITCH. Harry J. Hunsicker, Albany, N. Y. Filed May 29, 1907. Within the main oil pot is a pressure pot. In the bottom of the latter is a fixed electrode and movable electrode is arranged to pass through an aperture in the top of the pressure pot in making and breaking the circuit, thus rupturing any arc that may form.

977,198. COOLING-VANE FOR SECOND-CLASS GLOWER-LAMPS. Anton Kusebauch, Pittsburg, Pa., assignor to Nernst Lamp Company. Filed Nov. 11, 1908. The ballast tube of a Nernst lamp has a number of separate resilient cooling vanes surrounding the tube and located between it and the shell of the lamp.

977,219. ELECTRICAL SIGNALING SYSTEM. Clark H. Pool, New York, N. Y., assignor to International Electric Protection Company. Filed May 2, 1910. A transmitter for sending a succession of current impulses on the line has a number of loops in its circuit, and means for cutting a certain number of loops out of the circuit and for sending impulses corresponding to the number of loops cut out.

977,220. DYNAMO-ELECTRIC MACHINE. William H. Powell, Norwood, Ohio, assignor to Allis-Chalmers Company, and Bullock Electric Manufacturing Company. Filed July 30, 1906. Relates to a method of bracing the teeth of the laminated core. A number of laminae of greater stiffness than the teeth, but conforming in shape thereto are placed at each end of the core.

977,224. TROLLEY POLE. Robert F. Robinson and Henry A. Owen, Whitinsville, Mass. Filed Nov. 30, 1909. Near the head of the pole are a number of parallel springs making the arrangement a flexible one.

977,250. INCLOSED DYNAMO-ELECTRIC MACHINE. Alfred H. Wouters, Norwood, Ohio, assignor to Allis-Chalmers Company

and Bullock Electric Manufacturing Company. Filed Mar. 1, 1907. The ends of the rotor shaft are brought through the housing which is recessed at these points. Brushes are mounted at these recesses and bear on collector rings on the ends of the shaft.

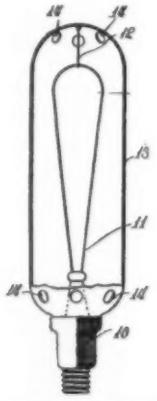
977,262. INSULATING HANGER. Neal Jay Bigham, Detroit, Mich., assignor to Harry A. Robertson, Grand Rapids, Mich. Filed April 28, 1910. The body portion of the insulator is provided with hanging hooks of which the bills are directed toward each other.

977,294. ELECTRICAL FLASHER. Arthur Sylvester Gibbs, Scranton, Pa. Filed Dec. 21, 1908. Contacts are made in a series or chambers containing mercury.

977,295. ELECTRICAL THERMOSTATIC ALARM SYSTEM. Albert Goldstein, New York, N. Y., assignor to International Electric Protection Company. Filed May 2, 1910. The thermostat has a case within which is a diaphragm moved by air expansion. The movement of the diaphragm first makes, then breaks, and finally again makes a circuit which operates an alarm device on the second make.

977,297. WALL SOCKET. Gilbert W. Goodridge, Brideport, Conn., assignor to Bryan Electric Company, Bridgeport, Conn. Filed July 21, 1909. The transmitter for alarm signals is operated by a certain frequency current which can be produced only by temperature variations.

977,303. ELECTRIC FURNACE. Johannes Härdén, London, England. Filed May 7, 1909. An induction furnace has a crucible formed in its walls. The walls are made of an intimate mixture of a refractory material and a suitable conductor.



977,361.—HELION HEATER.

977,328. ELECTRICAL EQUALIZING SYSTEM. Rudolf Richter, Grünau, near Berlin, Germany. Filed May 16, 1910. A generator has a set of commutator segments and brushes interposed between its exciter and its field winding. There are means for shifting the brushes as the load of the circuit varies.

977,331. ELECTRIC APPLIANCE FOR HORSES. John P. Sanborn, Cleveland, Ohio, assignor to Charles B. Tuttle, Detroit, Mich. Filed May 1, 1908. Has a supporting section adapted to be applied to the abdomen of the animal and an induction coil mounted upon the support.

977,335. MEANS FOR FILTERING AIR AND PRODUCING OZONE. Samuel C. Shaffner, Chicago, Ill., assignor to National Air Filter Company, Chicago, Ill. Filed May 10, 1909. A conducting wire screen is placed across a casing, one terminal of a high-tension transformer being connected to the screen. The core of the transformer is placed so as to assist in circulating the air by its heating effect. An electrode fan also provides circulation.

977,336. MEANS FOR FILTERING AIR AND PRODUCING OZONE. Samuel C. Shaffner, and Samuel T. Hutton, Chicago, Ill., assignors to National Air Filter Company. Filed June 26, 1909. Comprises a number of electrodes connected to the secondary of a high-tension transformer.

977,354. ELECTRIC RAILWAY. Robert Port Williams, San Francisco, Cal. Filed Oct. 29, 1908. A sectional third-rail system has a series of insulated trolleys carried beneath the overhang of the rail. A flexible bar extending downward from the car actuates these trolleys so that they become energized and transmit current through the bar to the car.

977,358. LAMP. Joseph E. Allen, Chicago, Ill. Filed Feb. 14, 1910. An electric bulb is inserted in a lamp made of a single piece of glass having only one opening therein.

977,361. RADIANT ELECTRIC HEATER. Raymond W. Baker, New York, N. Y., Victor L. King, Woodridge, N. J., and Herschel C. Parker, New York, N. Y., assignors to Parker-Clark Electric Company, New York, N. Y. Filed Dec. 29, 1909. A Helion lamp filament is mounted in a bulb having openings at its top and bottom so that a circulation of air can be maintained around the filament.

977,378. WEIGHING AND FILLING MACHINE. Harry Dunkerly, Houston, Tex. Filed Sept. 25, 1909. Renewed Oct. 3, 1910. Spouts are arranged for filling two sacks. Electrical means govern the opening and closing of valves in each spout.

977,391. AUTOMATIC SPRINKLER ALARM AND INDICATOR. Frank W. Milliken, Auburn, Me., assignor of one-half to Cheney C. Brown, Auburn, Me. Filed July 8, 1909. A portion of a pressure tank is adapted to move and thereby close an electric circuit connected with an annunciator.

977,398. TROLLEY RETRIEVER. Nels Peterson, Omaha, Neb., assignor to Murphy Did It Company, Omaha, Neb. Filed July 29, 1909. A retriever mechanism is mounted on top of the car and is connected to the hinge point and coiled spring of the pole.

977,400. BRUSH-HOLDER. Frederick W. Reeves, Pittsburg, Pa., assignor to Electric Accumulator Company, Pittsburg, Pa. Filed March 7, 1910. Includes a pair of plates, one disposed on the other, and means for putting a yielding pressure on each brush plate.

977,401. ELECTRIC CONTACT-SHOE. Charles Clayton Rich, Mount Vernon, N. Y., assignor of one-half to Harry J. Douglas, Mount Vernon, N. Y. Filed July 6, 1909. A contact shoe for a third rail.

977,416. TROLLEY HEAD. Earl N. McCall, Goldfield, Nev. Filed Dec. 21, 1908. The head carries two trolley wheels and a brush for cleaning the wire in front of the wheels.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired December 5:

509,873. SIGNALING-TELEGRAPH. Michael J. Burns, Lowell, Mass.

509,932. TESTING APPARATUS FOR MULTIPLE SWITCHBOARDS. Frank R. McBerty, Downers Grove, Ill.

509,953 and 509,955. REGULATOR FOR DYNAMO-ELECTRIC MACHINES. Charles E. Scribner, Chicago, Ill.

509,954. DYNAMO-ELECTRIC MACHINE. Charles E. Scribner, Chicago, Ill.

509,956. ANNUNCIATOR FOR TELEPHONE-SWITCHBOARDS. Charles E. Scribner, Chicago, Ill.

509,964. TELEGRAPH-KEY. Josef Steiner, Brooklyn, N. Y.

509,965. TELEPHONIC TRANSMISSION. John S. Stone, Boston, Mass.

510,002, 510,003, 510,004, 510,005, 510,006 and 510,007. TELEGRAPHY. Patrick B. Delany, South Orange, N. J.

510,018. INCANDESCENT ELECTRIC LAMP. Henry Green, Hartford, Conn.

510,048. ELECTRICAL APPARATUS FOR OPERATING DENTAL IMPLEMENTS. Oscar H. Pieper, San Jose, Cal.

510,059. ELECTRIC MOTOR. Arthur H. Beard, Manchester, Ala.

510,061. CONDUIT ELECTRIC RAILWAY. William R. De Voe, Shreveport, La.

510,074. ELECTRICAL MEASURING-INSTRUMENT. Otto T. Louis, Philadelphia, Pa.

510,095. SHADE FOR ELECTRIC LIGHT. George F. Seavey, Boston, Mass.

510,102. ELECTRIC MOTOR OR DYNAMO. Hermann K. Thiel, Alpena, Mich.

510,113. EMERGENCY WAGON FOR ELECTRIC LINE WORK. Edwin S. Breed, Waterbury, Conn.

510,115. ELECTRIC FIRE-ALARM. Milton C. Cantrell, Springfield, Ohio.

510,156. CIRCUIT-BREAKING APPARATUS. John Burry, New York, N. Y.

510,188. ELECTRIC-LIGHTING SYSTEM. George B. Pennock, Chicago, Ill.

510,195. AUTOMATIC TELEPHONE-EXCHANGE SYSTEM. John Serdinko, New Braunfels, Tex.

510,201. TROLLEY AND TROLLEY-SWITCH. David V. B. Smart, Troy, N. Y.

510,209. ELECTRIC TELEGRAPHY. Charles Thom, Jr., Brooklyn, N. Y.

510,260. ELECTRIC-ARC-LIGHTING SYSTEM. Daniel Higham, Boston, Mass.

510,276. PROCESS OF ELECTROLYTICALLY DECOMPOSING FUSED METALLIC CHLORIDES. Farnham M. Lyte, London, Eng.

510,303. ARC-LAMP SUPPORT AND CONNECTION. Lucius E. Thompson, Dunkirk, N. Y.

510,317. BRACKET FOR INCANDESCENT LIGHTS. Charles M. Berry, San Francisco, Cal.

510,320. MAGNETO APPARATUS. Arthur F. Boardman, Somerville, Mass.

510,367. RECIPROCATING ELECTRIC MOTOR. Arthur R. Roe, Duluth, Minn.

510,384. ELECTRICALLY-OPERATED RAILWAY-SWITCH. Henry L. Fsico, Brooklyn, N. Y.